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Venous Catheterization of the Heart

I. Indications, Technics, and Errors[1]

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WERNER FORSSMAN (10, 11) was the first to pass a catheter into the heart of a living patient, doing it first on himself, with the help of a surgical colleague who made the incision over the median basilic vein in the antecubital space. Others (13, 14) subsequently used the same technic for various purposes, and some of our radiological colleagues attempted visualization of the cardiac chambers and pulmonary arteries by this means (2). The lumen of the catheter, however, was too small to permit rapid filling of the chambers with radiopaque material, and the introduction of the Robb-Steinberg technic of angiocardiography (15) has made catheterization of the heart unnecessary for that purpose. Cournand and Ranges (3, 4) and their associates have used the method more than any group in this country, largely in the study of cardiovascular dynamics, particularly in shock. Their report in 1941 stimulated others to use the venous catheter, and at the present time a considerable literature has accumulated on the subject.

Cournand (5), in 1945, reported 1,200 such examinations with no fatalities and no serious complications from the passage of the catheter. However, we know of one death in another institution following the injection of diodrast through the catheter in a patient who had been injected with the same medium ten days before (16).

Fluoroscopy is an essential part of the procedure; yet we could find but one paper in the American radiological journals, that of Conte and Costa in RADIOLOGY, 1933 (2), mentioning the use of the right heart catheter for the purpose of better visualization of the pulmonary arteries. Most of the reports have been concerned with research problems and clinical investigations, but there are practical useful applications, particularly in the study of congenital heart disease, which we wish to emphasize.

INDICATIONS

Catheterization of the right heart is most useful in the study of hemodynamics, both in establishing the normals for physiological variations and the changes in the varied forms of heart failure, cardiopulmonary disease, and shock. It is valuable, also, in helping to establish the diagnosis more accurately in congenital heart disease. In addition, the method has been used in the study of cerebral, renal, and hepatic physiology in health and disease, by the collection of samples of blood from the

[1] From the Departments of Radiology, Peter Bent Brigham Hospital, and Harvard University Medical School, Boston, Mass. Presented before the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

jugular (Fig. 1, A), renal, or hepatic veins as desired.

In our series, the first 100 such examinations were done for the following purposes:

Congenital heart disease	39
Renal function studies	20
Normals	18
Other heart disease	15
Pulmonocardiac disease and others	8
TOTAL	100

The first such examination at the Peter Bent Brigham Hospital was done on Nov. 8, 1944, and the one-hundredth on Nov. 13, 1946. The original purpose of Dr. Dexter, who with his team has carried out all of these examinations without a single mishap, was to study renal physiology, but it soon became apparent that the method could be more useful in the study of congenital heart disease, particularly in helping to select suitable patients for operation, and most of our recent cases have been of this type. The exact and accurate antemortem diagnosis of the individual type of congenital heart disease, which was formerly interesting but unimportant, has now, with the tremendous advances in curative cardiac surgery, become necessary and important. This method is one which can be of great help in such cases, as Dr. Dexter will demonstrate in the following paper (6).

TECHNIC

The technic of performing venous catheterization of the heart has already been published (5). Slight modifications have been made from time to time by the different persons using the method. At present we use the single lumen catheter, size 9 French, made of woven silk, and radiopaque, with the orifice at the tip. It is 100 to 125 cm. in length, flexible, and yet stiff enough so that it can be rotated by twisting the exposed end, without buckling. It should have a slight curve or bend near the tip to facilitate its passage into the different parts of the cardiovascular system, which is done by aiming it in different directions under fluoroscopic observation.

Under strict aseptic precautions, an incision is made through the skin over the median basilic vein in either the right or left antecubital space, using novocaine anesthesia. The catheter is then threaded into the vein, advanced under fluoroscopic guidance, and "aimed" at the desired area by pushing and twisting the proximal end. Success in getting the tip into the various chambers and into the pulmonary arteries depends, as in fishing, upon the patience and persistence of the operator.

Radioscopy is done on a horizontal table equipped with a spot-film device, and is made as brief as possible, compatible with the demands in the individual case. We use 80 kv., 4 to 5 ma. of current, and as small a field (diaphragm) as possible. Observations are intermittent, not continuous, and the total exposure to any one part of the body surface is not allowed to exceed 10 minutes. A self-recording time-clock should be installed in the fluoroscopic circuit to prevent overexposure. For the same reason, all radioscopy in our department is controlled or supervised by one of the radiologists or residents in radiology. The spot films are made with 80 kv., 75 ma., and, in a patient of average thickness, an exposure of 0.2 second. This varies, of course, in younger and in more obese individuals from 0.1 to 0.4 second. In cases where there is some doubt as to the exact position of the tip of the catheter, oblique films are also taken.

The catheter is thus passed upward into the axillary vein, the superior vena cava, and into the right auricle. From there it may be passed downward into the inferior vena cava as the patient takes a deep inspiration, and into either right or left renal vein as desired, or into one of the hepatic veins. If the tip is turned medially in the right auricle by twisting the outer end, it may then be passed through the tricuspid valve into the right ventricle. The tip of the catheter moves with each cardiac pulsation—slightly in the auricle, but much more in amplitude of excursion when the right ventricle is entered. This helps to determine the intracardiac position of the

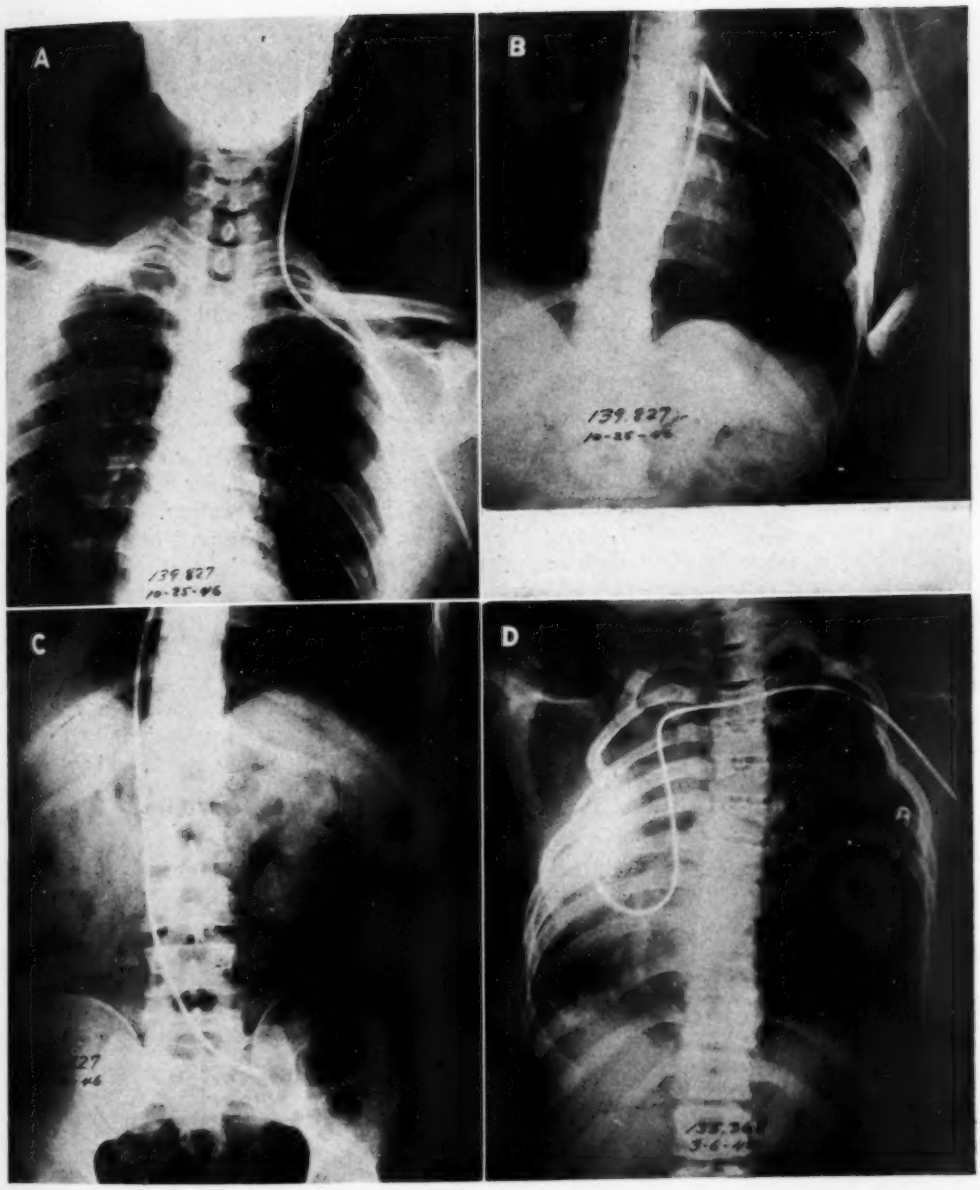

Fig. 1. Normal controls, illustrating possible positions of intravenous catheter. A. In left jugular vein. B. Through the right side of the heart with tip in left pulmonary artery. C. Through right auricle into inferior vena cava, tip in left iliac vein. D. Through left axillary vein, superior vena cava, and right auricle, with tip in right ventricle. The patient (J. Θ. S.) shown in D had aplasia of the upper and middle lobes of the right lung, confirmed by lipiodol bronchograms, and dextrocardia. The dense shadow around the tip of the catheter is diodrast in the right ventricle, injected through the catheter.

catheter. The sudden elevation of pressure and the vigorous systolic pulsations, as shown by the manometer, when the right ventricle is entered, also help to locate the catheter. It may be coiled up in the right auricle and thus give a reasonably good idea of the size of this chamber (Fig. 2).

From the right ventricle, the catheter may be introduced through the pulmonary valve into the pulmonary artery. At this point it may be guided into either the right or left pulmonary artery as desired, and may be passed well out into the smaller branches of the pulmonary artery until the tip occludes the branch in which it lies. In patients with congenital heart disease, two or three samples of blood are withdrawn through the catheter from the pulmonary artery or its branches, from the right ventricle, from the right auricle, and from the superior vena cava, and spot films are taken of the tip of the catheter in the various positions numbered to correspond to the numbered samples of blood. Before collecting the sample for analysis, 4 or 5 c.c. of blood are withdrawn and discarded, in order to avoid admixture and dilution with the saline perfusing the catheter. All samples are taken under oil to be analyzed for their oxygen content (5). The withdrawal of samples is facilitated by a Luer-Lok syringe with a tightly fitting adapter on the proximal end of the catheter. Clotting of blood in the catheter is prevented by a continuous perfusion of normal saline from a saline reservoir. Fifteen to sixty drops per minute is the usual rate of flow and is not enough to dilute the blood volume or to impair the accuracy of determinations from the samples taken. The hematocrit determinations and the oxygen capacity of the blood samples have been found to be unchanged during the procedure in a one-hour or two-hour period of observation.

The blood pressure in the various chambers was first recorded by a simple saline manometer, more recently by the Hamilton recording manometer (12). Blood flow to the periphery has been calculated by the direct Fick principle of dividing the oxygen consumption by the arteriovenous oxygen difference between the femoral artery and the right ventricle, right auricle, or superior vena cava, depending on which is nearest the abnormal shunt. The pulmonary flow has been calculated by dividing the oxygen consumption by the arteriovenous oxygen difference between the femoral artery (or, in the case of certain shunts, an assumed value of 95 per cent oxygenation in the pulmonary vein) and the pulmonary artery. All patients have a basal metabolism test on the morning of the procedure, just preceding the catheterization, to determine their oxygen consumption. Arterial blood is withdrawn under oil by puncture of the femoral artery, for determination of arterial oxygen saturation.

The comfort of the patient is important for the success of the test. A synthetic rubber mattress is used for all patients and does not interfere with fluoroscopy or films. The arm is supported on a comfortable rigid armrest projecting at a right angle from the table, allowing easy access to the operative field, permitting freedom of movement by the operator, and avoiding contamination of the sterile operative field by the fluoroscopic screen. The patient's head is made comfortable on soft pillows, with the face turned away from the area of operation. This also avoids trauma to the patient's nose and chin when the fluoroscopic screen is moved into position. Commotions, noises, conversation, and interruptions are kept to a minimum. Sedatives may be used in nervous or apprehensive individuals, and in young children anesthesia may be required. So far this has not been necessary in our series of cases.

Teamwork is essential. The minimum to secure adequate and accurate results would be three persons; the optimum number is five, namely, the catheter-passer, the instrument-handler (this includes the watching and regulating of the manometer, the saline reservoir, and the blood sample apparatus), a radiologist, a general handyman or *diener*, and a chemist to analyze the blood samples. The analyses

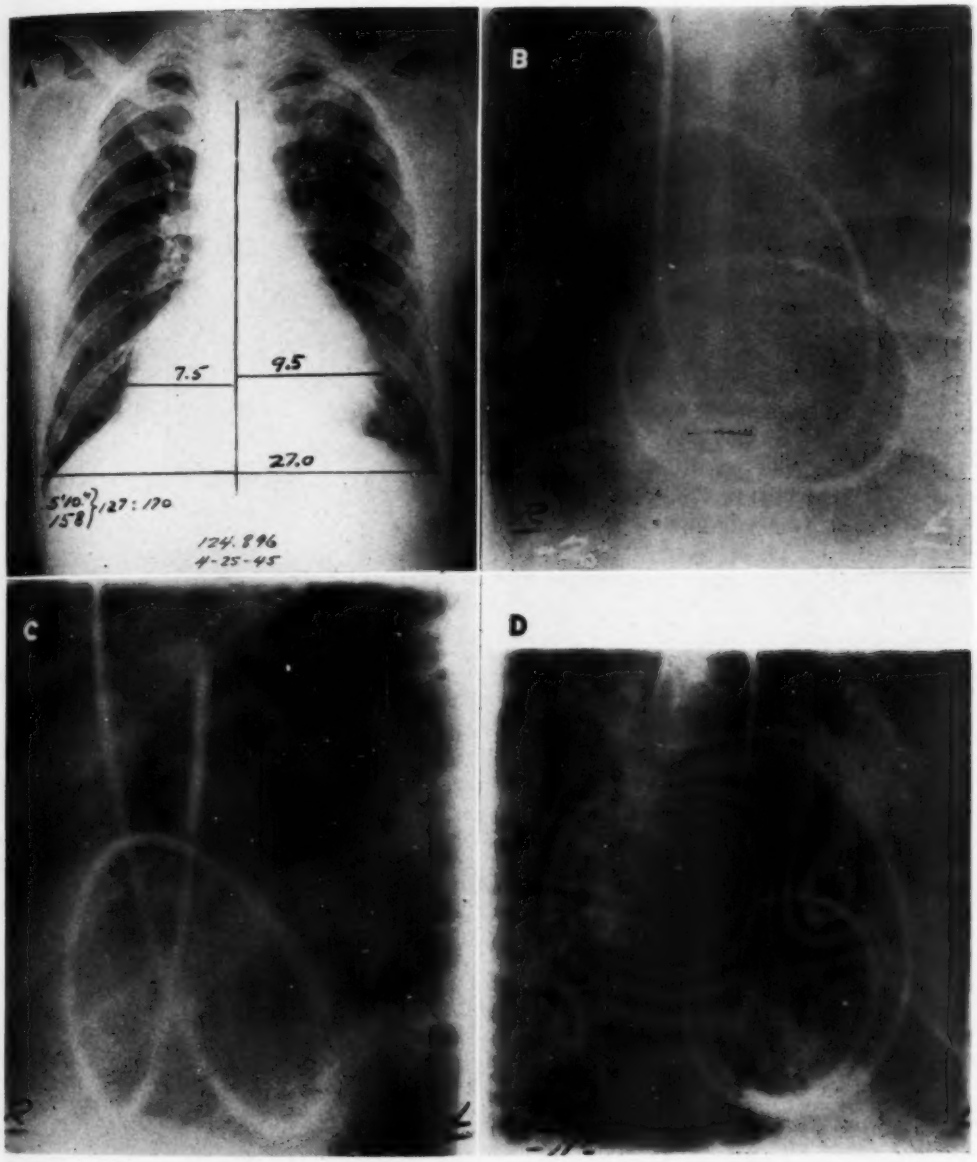

Fig. 2. Course and position of the catheter in a patient with ventricular septal defect and large right auricle. A. Seven-foot film of the heart. B. Spot film in postero-anterior position, showing catheter coiled in large right auricle, with the tip in the right pulmonary artery. C. Same as B, in left anterior oblique position. D. Same as B, in right anterior oblique position. The double contour of parts of the catheter is due to pulsations.

Patient J. B., aged 48, white male. · Known heart lesion since age of 3; cyanosis and clubbing all his life. Loud grating systolic murmur best heard over fourth left interspace, widely transmitted. Pulmonic second sound accentuated. Polycythemia (r.b.c. 5.56 million, Hb. 17.3 gm., hematocrit 53), EKG compatible with dextrocardia. X-ray studies revealed situs inversus abdominis, heart enlarged to right, right-arched aorta. Findings on catheterization: *Right auricle:* oxygen content 15.5 volume per cent, oxygen saturation 72%, pressure 8 mm. Hg. *Right ventricle:* 19.3 volume per cent, 90.5%, 15 mm. Hg. *Pulmonary artery:* 16.6 volume per cent, 77%, 17 mm. Hg. *Femoral artery:* 19.9 volume per cent, 92%. Results indicate entrance of arterial blood into right ventricle, which without pulmonic stenosis and with cyanosis and clubbing suggest Eisenmenger's complex. Patient also had right-arched aorta demonstrable by x-ray, and double superior vena cava (see Fig 3, B).

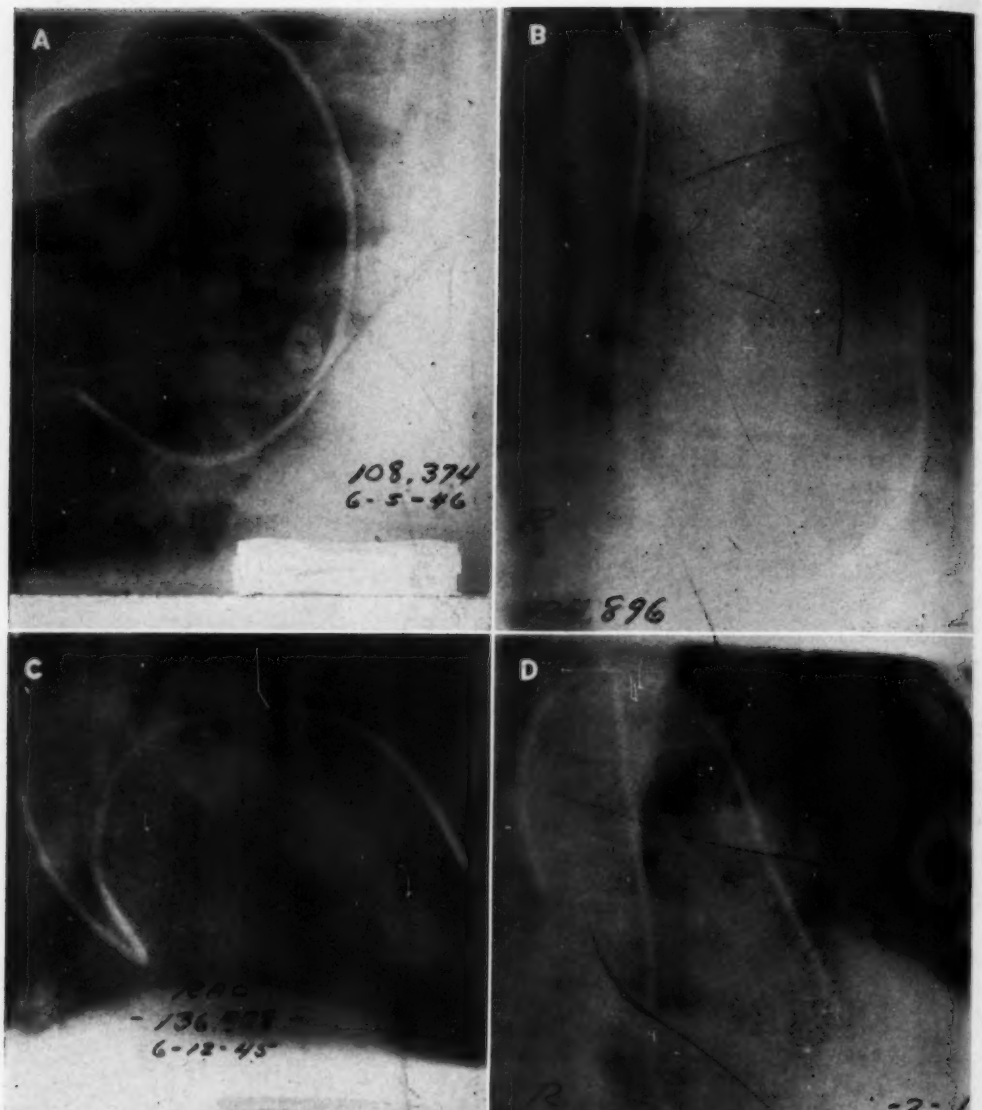

Fig. 3. Several unusual positions of the catheter. A. Presumably in the azygos vein. Oxygen content 10.7 volume per cent = 63% saturated, same as superior vena cava. B. Down right superior vena cava, through right auricle and presumably up left superior vena cava. Oxygen content 14.2 volume per cent = 65% saturated, same as in right superior vena cava. C. Catheter through right auricle into coronary venous sinus. The catheter maintained the same curve and position in oblique films, and the distal portion lay just within the cardiac outline close to the pericardial margin. Oxygen content 7.4 volume per cent = 25% saturated, pressure 12 mm. Hg. This very low oxygen saturation suggests blood from the coronary vein, in addition to the anatomical location of the catheter. D. Catheter in right-arched aorta, tip in descending aorta beside the spine, right anterior oblique position. Oxygen 84% saturated, pressure through catheter 110/70 mm. Hg.

D. Patient H. S., aged 10. Known heart murmur since six weeks of age, mild cyanosis since birth, no clubbing.

[*Legend continued on opposite page*]

have been done in Dr. Burwell's laboratory; the instruments have been prepared and cared for most adequately by Dr. Florence Haynes; Dr. Lewis Dexter has done the actual passing of the catheter; and the radioscopy has been done successively by my residents, Dr. Roy Seibel and Dr. Robert Sagerson.

FAILURES AND ERRORS

Failure to secure adequate or reliable data from this test has been infrequent; only 13 examinations out of 100 were unsatisfactory. Spasm of the vein around the catheter in the arm may prevent passage to the desired spot but has not interfered with withdrawal of the catheter. Venospasm is more apt to occur if the patient is uncomfortable or in pain, and less apt to occur with good local anesthesia and with use of the rubber mattress. Novocaine should be used liberally around the skin incision. Two examinations were unsatisfactory owing to venospasm. Two others failed because of a poor catheter which did not have the proper curve at the tip and which could not be guided where desired. The other failures were due to kinking of the catheter at junction points in the venous system, to inexperience early in the series, to uncooperative patients, to failure of the manometer in one case, and to lack of adequate veins in two cases.

The errors inherent in the application of the Fick principle for calculating cardiac output by this method have been discussed by Warren, Stead, Weens, and Brannon (1, 17), particularly in relation to variations due to anxiety and to postural changes, and to the determination of cardiac output in man. They report results of observations on over 500 subjects and are concerned chiefly with the difficulty of obtaining well-mixed venous blood from the right auricle and right ventricle. In their series, variations in oxygen content of blood from the right auricle and right ventricle were within reasonable agreement in 80 per cent of the determinations (not more than 0.4 volume-per cent), but exceeded this variation in the remaining 20 per cent. They conclude that if the right auricle or right ventricle is used as a source of venous blood for the determination of cardiac output, results will be accurate if treated statistically, but in individual cases errors of considerable magnitude may occur.

Cournand *et al.*, however, found the percentage and degrees of error to be considerably less than reported by Stead *et al.* and concluded that usually, but not always, well-mixed venous blood could be obtained in the right auricle close to the orifice of the tricuspid valve.

The findings of Stead and of Cournand and their co-workers have been confirmed in our hospital by Dexter *et al.* (7, 8, 9). They have emphasized that blood in the right auricle and right ventricle occasionally varies considerably in oxygen content, probably due to the withdrawal of coronary venous blood (thebesian veins, coronary sinus). On the other hand, if several samples of blood are obtained from the pulmonary artery, there is rarely any significant variation in their oxygen content. These workers conclude that the Fick principle of calculating cardiac output is valid if the pulmonary artery is used as the source of mixed venous blood.

Cournand and associates (3) and Stead *et al.* (17) found that the calculated cardiac output by the direct Fick method was 20 to 25 per cent higher than that with the methyl iodide and acetylene gas methods.

Some of the abnormal or unexpected situations in which the tip of the catheter was found are shown in the accompanying

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Loud machinery murmur maximum in aortic area, no thrill. Hb. 17.3 gm., hematocrit 49. Circulation time, magnesium sulfate method, 8 seconds. X-ray examination revealed cardiac enlargement, chiefly left ventricle, dilated and engorged hilar vessels, and a right-arched aorta. EKG showed right axis deviation. Findings on catheterization: *Right auricle:* oxygen content 12.0 and 13.0 volume per cent, pressure 4 mm. Hg. *Right ventricle (proximal):* 14.0 volume per cent. *Right ventricle (distal):* 17.0 volume per cent, pressure 4 mm. Hg. *Aorta:* 18.7 volume per cent = 84% saturated, pressure 110/70 mm. Hg. Catheter did not enter pulmonary artery. *Conclusions:* Tetralogy of Fallot plus right-arched aorta (Corvisart's syndrome) probably with patent ductus arteriosus. Calculated pulmonary blood flow through ductus arteriosus, assuming pulmonary atresia, 6.7 l./min.; peripheral blood flow 2.7 l./min.

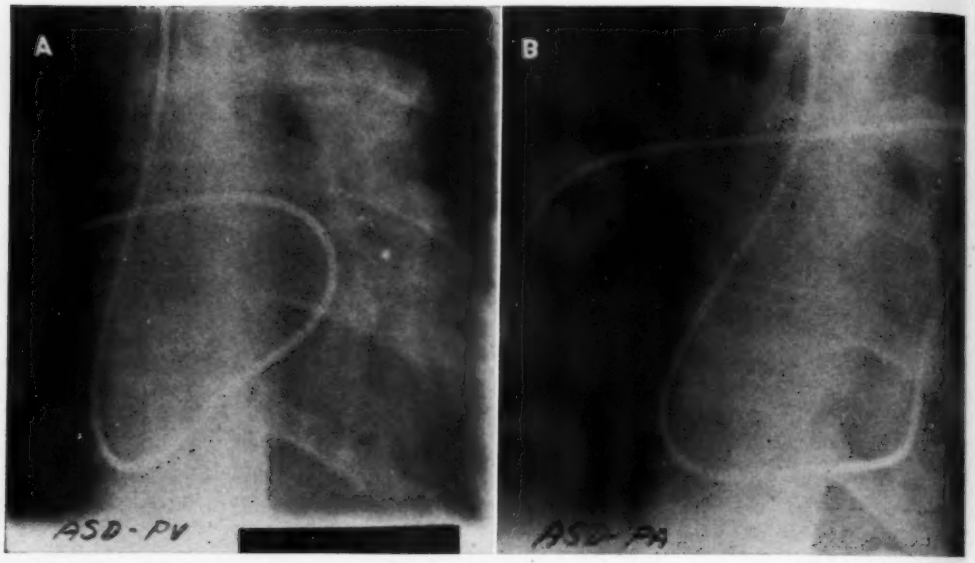

Fig. 4, A and B. Case of auricular septal defect with catheter passing through the defect into the left side of the heart. A. Catheter through auricular septal defect into left auricle and pulmonary vein. B. Catheter through right ventricle into pulmonary artery, same patient, same position.

Patient K. R., female, aged 43. Blue baby, slight cyanosis and clubbing all her life. Grade 3 diastolic murmur maximal in fourth left intercostal space. EKG showed right axis deviation. Marked dilatation of pulmonary arteries demonstrable by x-ray. Oxygen content of blood in position A: 18.8 volume per cent = 98% saturation, pressure 32/20 mm. Hg; in position B: 13.1 volume per cent = 68% saturation, pressure 85/32 mm. Hg.

illustrations, *e.g.*, in the coronary vein (2 cases)(Fig. 3, C), in the azygos vein (Fig. 3, A), in the aorta (2 cases of tetralogy of Fallot)(Fig. 3, D), in a double superior vena cava (2 cases), and, after passing through an auricular septal defect, in the left auricle and pulmonary veins (2 cases) (Fig. 4). The results of the pressure readings and the oxygen content of blood samples in patients with congenital heart disease are discussed by Dr. Dexter in the following paper. An early misleading finding was that of a higher-than-normal oxygen content in the pulmonary artery when the tip of the catheter was as far out as it would go in the artery. It took but a little reasoning, deduction, and further investigation, however, to explain this finding on the ground that the catheter had occluded the lumen of the small artery and that therefore the blood withdrawn through the orifice in the tip of the catheter really came back from the pulmonary capillaries and veins, where the oxygen content would be that of the arterial blood.

DANGERS AND SEQUELAE

When trying to pass the tip of the catheter through the tricuspid valve, ventricular extra systoles occur in about half of the cases. This is the only subjective sensation in the great majority of patients. A few have mentioned an accompanying sensation of tightness in the substernal area or neck, and one patient was made breathless when the tip of the catheter was still in the right auricle. In only two instances were the subjective symptoms distressing enough to cause abandonment of the procedure.

The dangers most commonly feared are damage to the endothelium of the large veins or of the heart, and the possibility of thrombus formation in or on the catheter. So far no thrombi have been formed on the waxed catheter, and no clots in the catheter have formed if the saline perfusion is kept going at 15 drops per minute or more. Several of this group of patients have succumbed to their disease or conditions not in any way related to the procedure, and in 10

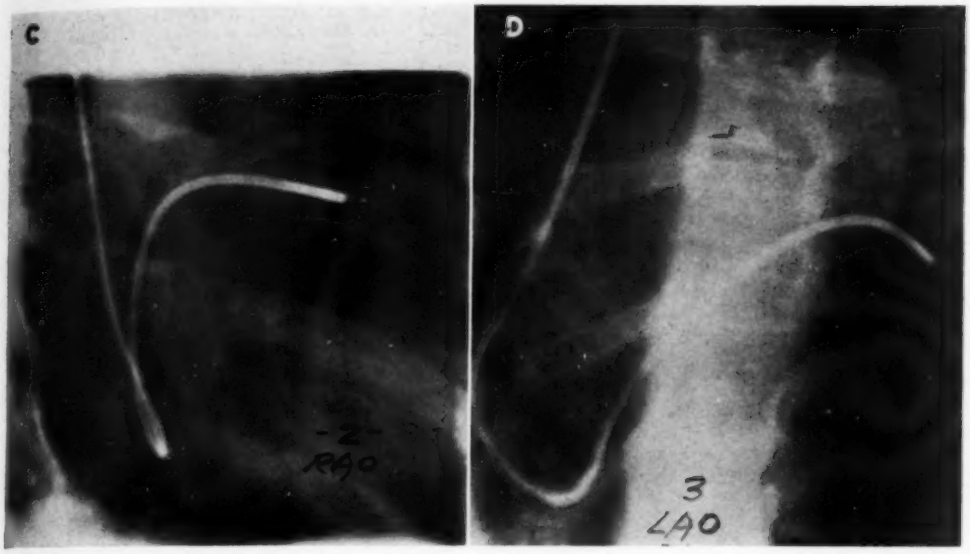

Fig. 4, C and D. Another case of auricular septal defect. C. Catheter through auricular septal defect into left auricle and pulmonary vein, patient in right anterior oblique position. D. Same, patient in left anterior oblique position.

Patient E. M., female, aged 25. Cyanosis for five years, no clubbing. Harsh diastolic murmur without thrill, maximal at fourth left intercostal space. X-ray study of heart revealed marked cardiac enlargement and huge pulmonary arteries. EKG showed right axis deviation. Catheter results were as follows:

	Oxygen content, volume per cent	Oxygen saturation, per cent
Superior vena cava	13.0	60
Inferior vena cava	15.6	72
Right auricle	14.2	66
Left auricle	19.6	91
Pulmonary vein	21.2	97
Femoral artery	18.7	89

autopsies no trace of damage could be found in the lining endothelium of the superior vena cava, the right auricle, the right ventricle, the pulmonary arteries, or on the valves. Many of the patients have local thrombosis of the vein at the point of incision, and a few have had mild inflammatory reactions around the area of skin incision. All have subsided promptly on conservative treatment with no deleterious sequelae.

The results of this procedure, the diagnostic dividends as it were, are discussed by Dr. Dexter in the following paper.

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Venous Catheterization of the Heart

II. Results, Interpretations, and Value[1]

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CONGENITAL heart lesions are notorious for their lack of characteristic signs and symptoms. The addition of venous catheterization, as developed by Cournand and Ranges (1), to the work-up of these cases presents an opportunity for the recognition of certain defects, for an estimation of the physiological magnitude of the shunts of blood, and for the study of the circulatory dynamics of these patients. Details of the procedure and methods of calculation of blood flows have been reported elsewhere (2, 3, 4, 5). Findings in representative types of congenital heart disease are herein described.[2]

AURICULAR SEPTAL DEFECT

In the presence of an auricular septal defect, blood usually flows from the left auricle to the right auricle. The venous catheter is helpful in the recognition of this defect by two methods, as described by Brannon, Weens, and Warren (6). The catheter may be introduced through the defect (4, 5) or arterial blood may be found in the right auricle (4). The following case report illustrates both methods in the same patient.

Case Report: K. R., a 43-year-old woman, had been a blue baby and had had cyanosis and clubbing of the fingers all her life. Since the age of 19 she had had exertional dyspnea, which had not been progressive. Physical examination showed her to be undernourished but active, with slight cyanosis and clubbed fingers and toes. The heart was enlarged to the left. A grade-3 diastolic murmur was present in the fourth left intercostal space. The pulmonic second sound was accentuated. There were no physical signs of heart failure. An electrocardiogram showed right axis deviation. Roentgenography (Fig. 1) and fluoroscopy of the heart revealed extreme dilatation and pulsation of the pulmonary artery and its branches. On venous catheterization (Fig. 1), the catheter entered the right auricle and passed through a defect in the auricular septum into a pulmonary vein, where the oxygen saturation of the blood was 98 per cent (Table I). The femoral arterial oxygen saturation was only 86 per cent. The catheter was subsequently introduced into the right ventricle and pulmonary artery. The results are shown in Table I. A diagnosis of auricular septal defect seemed justified on the basis of finding arterial blood in the right auricle and of introducing the catheter through the defect.

TABLE I: AURICULAR SEPTAL DEFECT (PATIENT K. R.)

Source of Blood	Oxygen Content, c.c./l.	Oxygen Saturation, %	Pressure, mm. Hg
Superior vena cava	115	60	....
Right auricle	132	69	0
	130	68	
	114	59	
	133	70	
	178	93	
Pulmonary vein	188	98	32/20
Right ventricle, upper	132	69	85/0
Pulmonary artery, branch	131	69	85/32
	133	70	
	131	69	
Femoral artery	165	86	104/70

A-P diameter of chest	19	cm.
Oxygen consumption	171	c.c./min.
Body surface	1.54	sq. m.
Oxygen gain by blood in lungs	57	c.c./l.
Oxygen loss by blood in periphery	50	c.c./l.
Pulmonary blood flow	3.0	l/min.
Peripheral blood flow	3.4	l/min.
Flow through defect		
Left to right	0.7	l/min.
Right to left	1.1	l/min.

[1] From the Medical Clinic, Peter Bent Brigham Hospital, and the Department of Medicine, Harvard Medical School, Boston, Mass. Presented before the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

[2] The team for venous catheterization at the Peter Bent Brigham Hospital has consisted of Drs. M. C. Sosman, R. E. Seibel, R. P. Sagerson, and M. H. Wittenborg of the Department of Radiology; Drs. F. W. Haynes, H. K. Hellems, and L. Dexter; and Drs. C. S. Burwell, E. C. Eppinger, and J. M. Evans of the Department of Medicine.

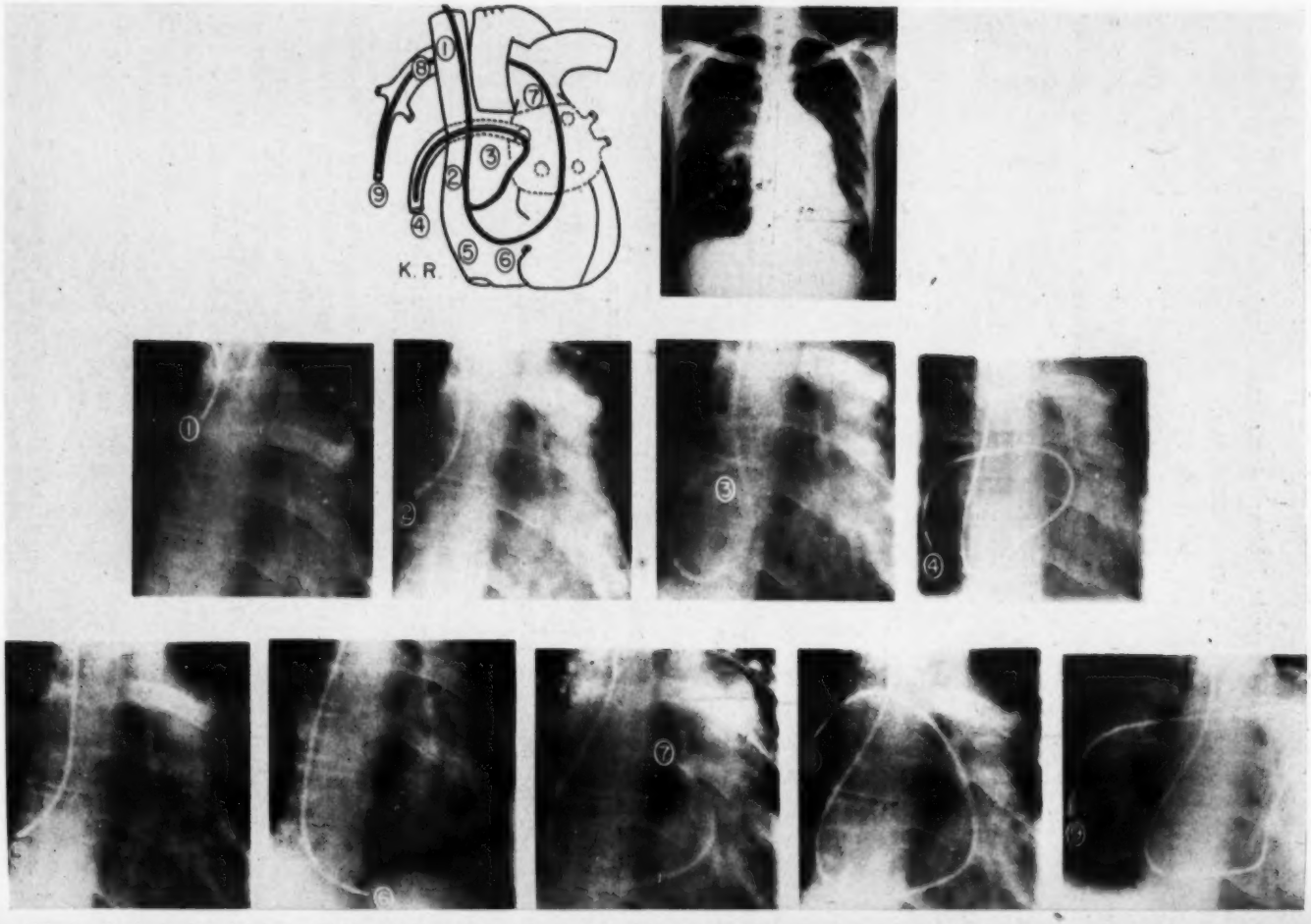

Fig. 1. Auricular septal defect. The positions of the catheter are identifiable by the corresponding numbers in the schema. In position 4, the catheter passed into the pulmonary vein through a defect in the interauricular septum. Blood withdrawn from this position was arterial (see Table I). In positions 8 and 9, the catheter passed through the right ventricle into the right branch of the pulmonary artery. Blood withdrawn at these sites was venous.

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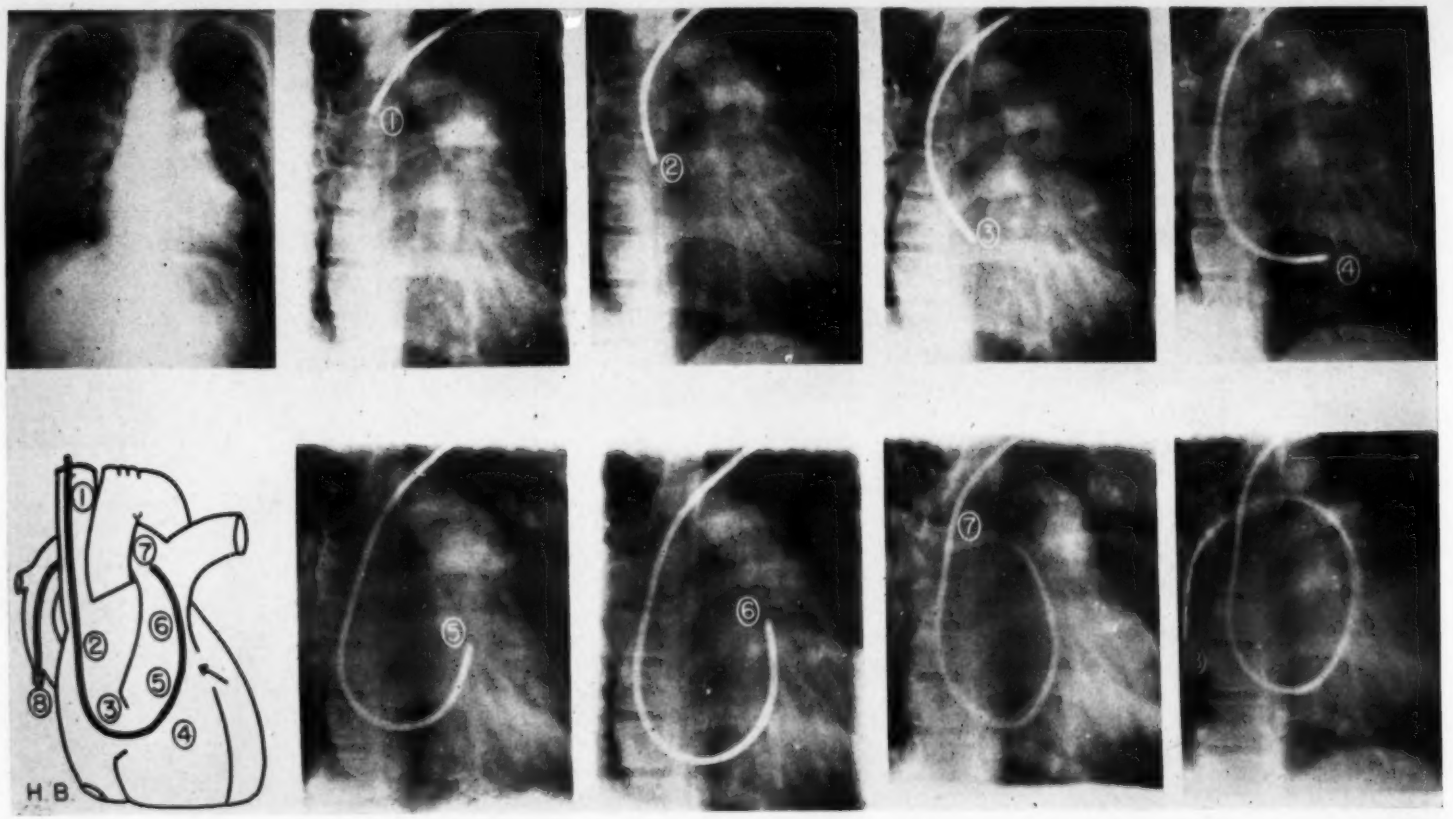

Fig. 2. Ventricular septal defect. The positions of the catheter are identifiable by the corresponding numbers in the schema.

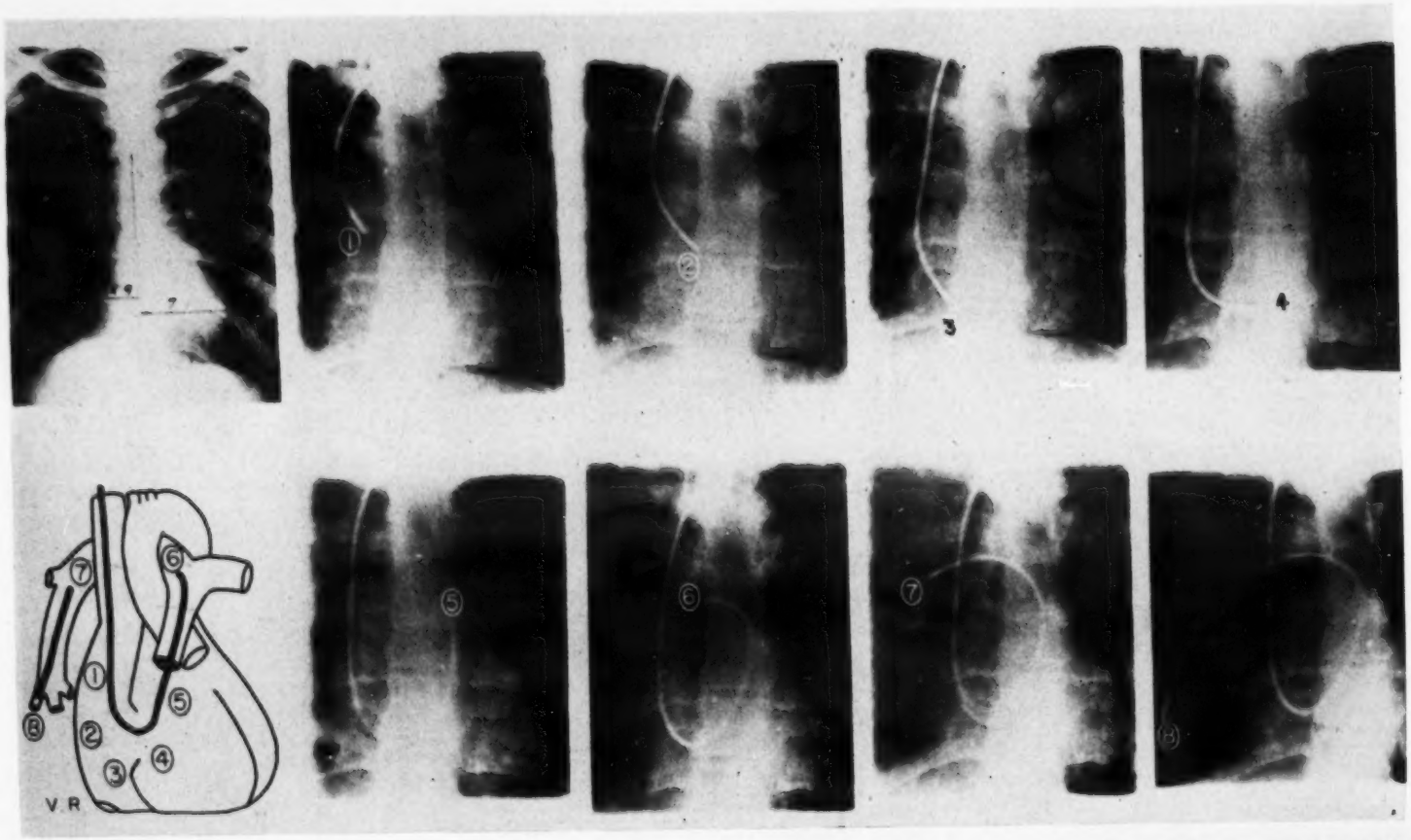

Fig. 3. Tetralogy of Fallot. The positions of the catheter are identifiable by the corresponding numbers in the schema. Note that the catheter passed through the stenotic pulmonary valve into the pulmonary artery.

VENTRICULAR SEPTAL DEFECT

An uncomplicated defect in the interventricular septum results in a shunting of arterial blood from the left ventricle to the right ventricle. Its recognition by venous catheterization depends on finding a significantly higher content of blood in the right ventricle than in the right auricle. Two such cases have been recently described by Baldwin, Moore, and Noble (7).

Case Report: H. B., a 10-year-old boy, kindly referred by Dr. Samuel A. Levine, had had a known murmur since infancy. He had grown and developed normally and denied any limitation of activity. There was no history of cyanosis. Physical examination revealed a harsh grade-5 systolic murmur and thrill maximal at the third left intercostal space and a resounding pulmonic second sound. Roentgenography (Fig. 2) and fluoroscopy of the heart revealed prominence in the region of the pulmonary artery and engorgement and pulsation of the hilar vessels. An electrocardiogram showed right axis deviation. Venous catheterization was performed, as shown in Fig. 2, and the results are presented in Table II.

TABLE II: VENTRICULAR SEPTAL DEFECT (PATIENT H. B.)

Source of Blood	Oxygen Content, c.c./l.	Pressure, mm. Hg
Superior vena cava	133	....
Right auricle		
Upper	135	15
At valve	126	
Right ventricle		
Lower	156	
Mid	165	100/15
Upper	165	
Pulmonary artery, branch	161	100/49
	161	
Femoral artery	183 (98%)	153/98

A-P diameter of chest	15.0 cm.
Oxygen consumption	189 c.c./min.
Body surface	1.1 sq. m.
Oxygen uptake by blood in lungs	22 c.c./l.
Oxygen loss by blood in periphery	52 c.c./l.
Pulmonary blood flow	8.6 l/min.
Peripheral blood flow	3.6 l/min.
Flow through defect	5.0 l/min.

It is seen that a considerable amount of arterial blood entered the right ventricle as indicated by the higher oxygen content of blood in the right ventricle than in the right auricle. Using the direct Fick principle for the calculation of blood flow (2), 5.0 liters of blood were calculated to flow through the defect per minute. Pressures in the pulmonary artery and right ventricle were greatly in excess of normal.

TETRALOGY OF FALLOT

The tetralogy of Fallot consists of pulmonic stenosis, interventricular septal defect, over-riding or dextro-position of the aorta, and right ventricular hypertrophy. Due to the pulmonic stenosis, venous blood enters the pulmonary artery with difficulty and some is shunted through the septal defect and into the aorta. These patients are, therefore, cyanotic and suffer mainly from a deficient blood flow through the lungs. The venous catheter may follow one of two courses. It may pass through the stenosed pulmonary valve into the pulmonary artery, or it may pass through the interventricular septal defect and go directly into the over-riding aorta.

TABLE III: TETRALOGY OF FALLOT (PATIENT V. R.)

Source of Blood	Oxygen Content, c.c./l.	Pressure, mm. Hg
Right auricle		
Upper	207	
Lower	195	(9)
Near valve	189	
Right ventricle		
Mid	210	140/9
Upper	198	35/8
Pulmonary artery		
Stem	198	18/8
Branch	204	
Pulmonary "capillaries"	276 (97%)	....
Femoral artery	233 (82%)	....

A-P diameter of chest	19.5 cm.
Oxygen consumption	169 c.c./min.
Body surface	152 sq. m.
Oxygen uptake by blood in lungs	75 c.c./l.
Oxygen loss by blood in periphery	36 c.c./l.
Pulmonary artery blood flow	2.3 l/min.
Peripheral blood flow	4.7 l/min.
Flow through defect	
Right to left	2.6 l/min.
Left to right	0.2 l/min.

Case Report: An example of the former instance was V. R., a 20-year-old woman who had been a "blue baby" and had always had cyanosis, clubbing, and moderate restriction of activity. Physical examination showed normal development and a grade-3 pulmonic systolic murmur without thrill. In x-ray films of the heart (Fig. 3) the apex appeared to be lifted up from the diaphragm, the hilar vessels

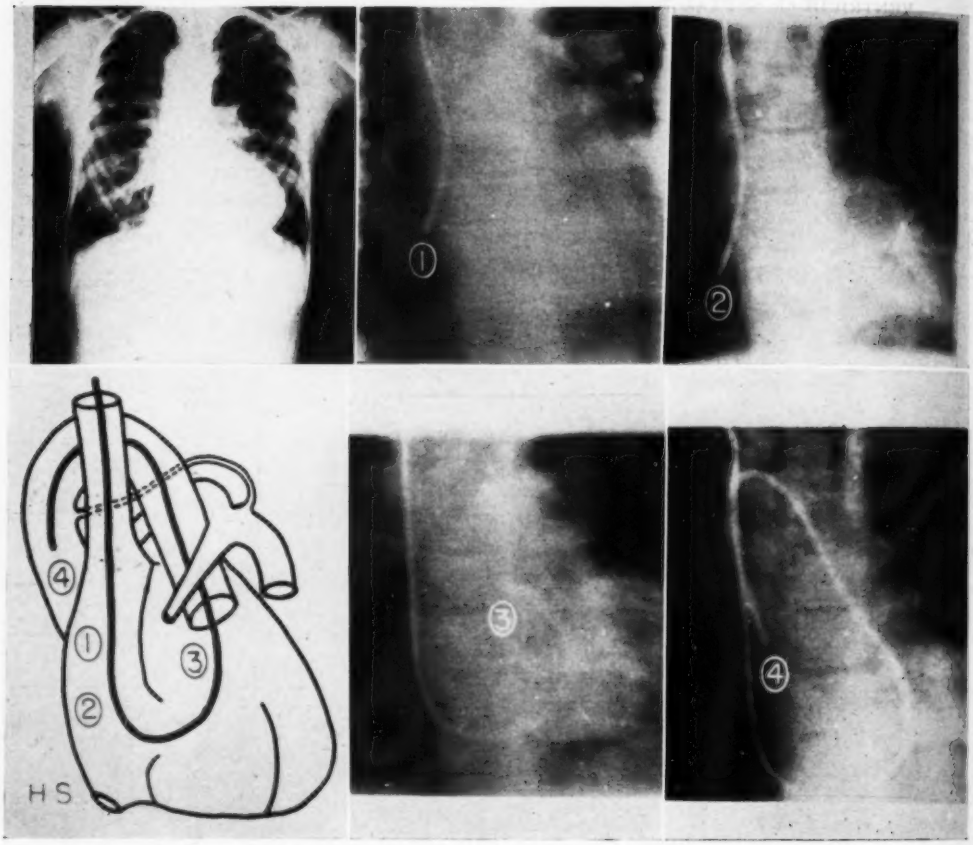

Fig. 4. Tetralogy of Fallot, right-arched aorta, patent ductus arteriosus. The positions of the catheter are identifiable by the corresponding numbers in the schema. Note that the catheter passed through the right ventricle and into the right-arched aorta.

were less prominent than normal, and the size of the pulmonary artery was within normal limits. The important findings on venous catheterization are shown in Fig. 3 and Table III. The catheter passed into the pulmonary artery without difficulty. Pulmonary stenosis was indicated by the elevated pressure in the right ventricle and the low pressure in the pulmonary artery. An infundibular stenosis was suspected on finding a much lower pressure in the infundibular portion of the right ventricle than in the lower part of the right ventricle. This pressure difference in the two parts of the right ventricle was checked several times. Blood withdrawn from the pulmonary capillary and venous bed, as described elsewhere (3, 8), had an oxygen saturation of 96 per cent, and a simultaneous sample withdrawn from the femoral artery was only 82 per cent saturated. In the absence of roentgenologically demonstrable pulmonary disease, this finding was interpreted as indicating the existence of a right-to-left shunt of blood. This shunt was assumed to be present through a defect in the interventricular septum because of the associated pulmonic stenosis. A diagnosis of tetralogy of Fallot seemed justified.

Case Report: This case illustrates the passage of the catheter from the right ventricle into the aorta. H. S., a 10-year-old boy, kindly referred to us by Dr. Samuel A. Levine, had been observed to have a heart murmur in infancy. He had never been as active as his playmates and had always had a cyanotic tinge to his nails and lips. His heart was enlarged (Fig. 4), and a typical machinery murmur of patent ductus arteriosus was present in the aortic rather than in the pulmonary region. The venous catheter passed through the right ventricle and into the aorta (Fig. 4). From the course of the catheter, it is apparent that the patient had a right-arched aorta and either a ventricular septal defect or an over-riding aorta, or both. Pulmonary stenosis was assumed on finding a right ventricular systolic pressure identical with that of the aorta (Table IV). This assumption has been confirmed in another case

TABLE IV: TETRALOGY OF FALLOT AND PATENT DUCTUS ARTERIOSUS (PATIENT H. S.)

Source of Blood	Oxygen Content, c.c./l.	Pressure, mm. Hg
Aorta	187 (84%)	110/70
Right auricle		
Mid	130	4
Upper	120	
Right ventricle		
Near pulmonary valve	173	110/4
Near tricuspid valve	140	

A-P diameter of chest	17.5	cm.
Oxygen consumption	166	c.c./min.
Body surface area	1.22	sq. m.
Pulmonary arteriovenous oxygen difference (assuming patent ductus arteriosus as only source and 95% oxygen saturation of pulmonary venous blood)	25	c.c./l.
Peripheral arteriovenous oxygen difference	62	c.c./l.
Pulmonary blood flow (through patent ductus arteriosus assuming pulmonary atresia)	6.7	1/min.
Peripheral blood flow	2.7	1/min.

by autopsy. Since the catheter could not be introduced into the pulmonary artery, the existence of a patent ductus arteriosus had to be assumed because of the quality of the murmur. Its location on the right side was probably determined by the arching of the aorta to the right.

PATENT DUCTUS ARTERIOSUS

Patent ductus arteriosus is a vascular anastomosis between the aorta and pulmonary artery which during fetal life serves to by-pass the lungs. Its persistence after birth is deleterious, owing to the ease with which bacterial vegetations become implanted and also to the circulatory strain thrown on the left ventricle. Since the flow of blood after birth is from the aorta, where the pressure is high, to the pulmonary artery, where it is low, there is no cyanosis and the lesion is detectable on venous catheterization by finding arterial blood in the pulmonary artery or, in other words, blood with a higher oxygen content in the pulmonary artery than in the right ventricle.

Case Report: S. I., a 7-year-old girl, had had a normal birth and development and at the age of 5 was found to have a heart murmur. She had never experienced any symptoms referable to the heart. Physical examination revealed no cyanosis or clubbing. The blood pressure was 108/20 mm. Hg. The heart was overactive and enlarged to the left. A typical "machinery" murmur, accompanied by a systolic thrill, was present in the third left intercostal space. X-ray study of the heart (Fig. 5) showed it to be enlarged to right and left, with marked engorgement of the hilar vessels. Venous catheterization was performed as shown in Table V. It is seen that the oxygen content of blood in the pulmonary artery had a significantly higher oxygen content than

TABLE V: PATENT DUCTUS ARTERIOSUS PREOPERATIVE (PATIENT S. I.)

Source of Blood	Oxygen Content, c.c./l.	Pressure, mm. Hg
Superior vena cava	98	....
Right auricle		
Upper	100	18
Mid	104	
Right ventricle		
Lower	103	48/18
Upper	114	
Pulmonary artery	137	48/33
Pulmonary "capillaries"*	156 (97%)	....

A-P diameter of chest	14.5	cm.
Oxygen consumption	167	c.c./min.
Body surface area	0.85	sq. m.
Oxygen uptake by blood in lungs	19	c.c./l.
Oxygen loss by blood in periphery	54	c.c./l.
Pulmonary blood flow	8.8	1/min.
Peripheral blood flow	3.1	1/min.
Flow through shunt	5.7	1/min.

* This value is the same as that in a systemic artery when no right-to-left shunt exists (7, 8).

TABLE VI: PATENT DUCTUS ARTERIOSUS POSTOPERATIVE (PATIENT S. I.)

Source of Blood	Oxygen Content, c.c./l.	Pressure mm. H
Right auricle		
Upper	134	3
At valve	134	
Right ventricle		
Lower	136	
Mid	133	32/3
Upper	135	
Pulmonary artery		
Stem	137	32/10
Branch	136	
Femoral artery	175 (97%)	....

A-P diameter of chest	14.5	cm.
Oxygen consumption	150	c.c./min.
Body surface area	0.85	sq. m.
Oxygen uptake by blood in lungs	40	c.c./l.
Oxygen loss by blood in periphery	40	c.c./l.
Pulmonary blood flow	3.8	1/min.
Peripheral blood flow	3.8	1/min.
Flow through shunt	None	

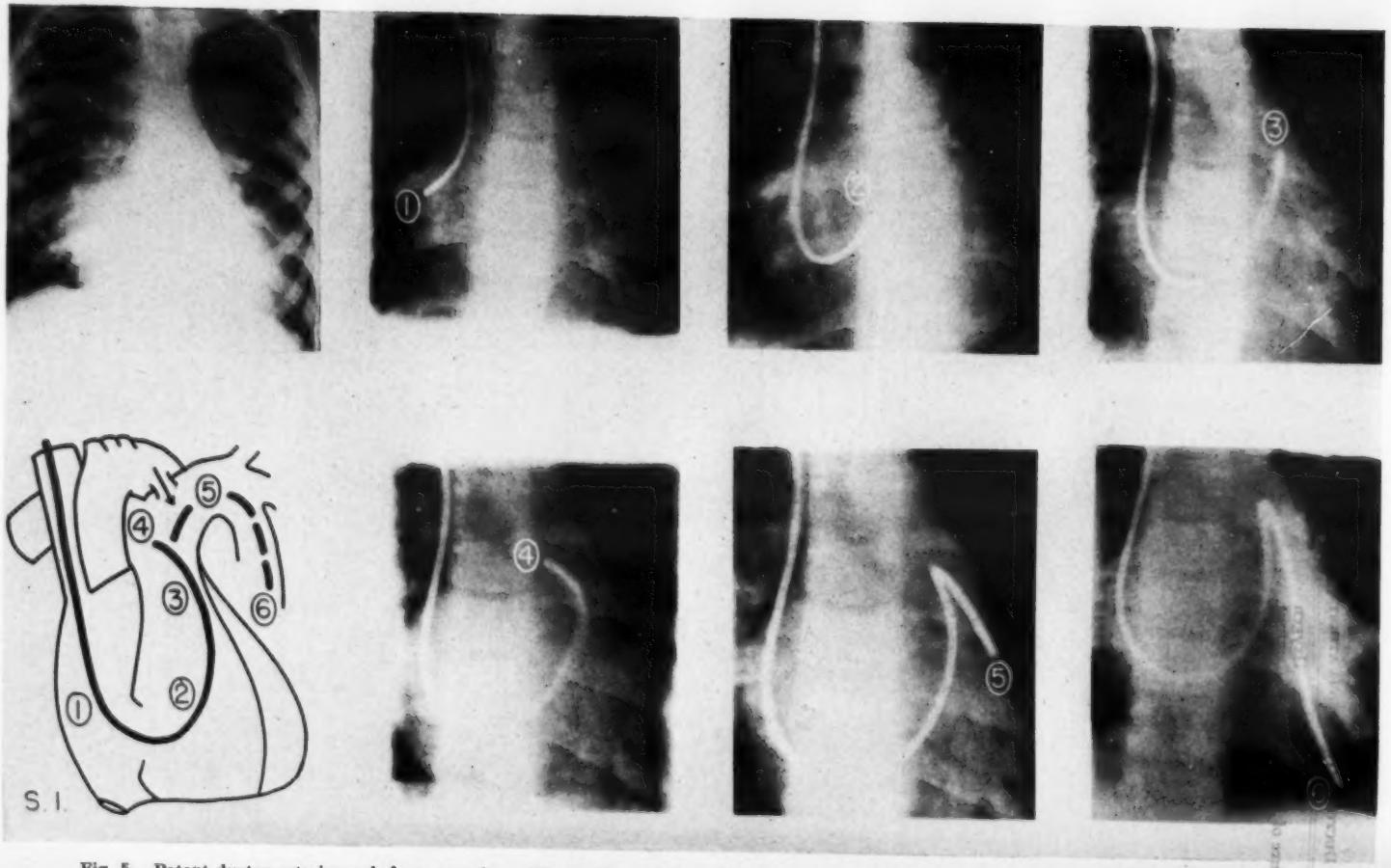

Fig. 5. Patent ductus arteriosus, before operation. The positions of the catheter are identifiable by the corresponding numbers in the schema.

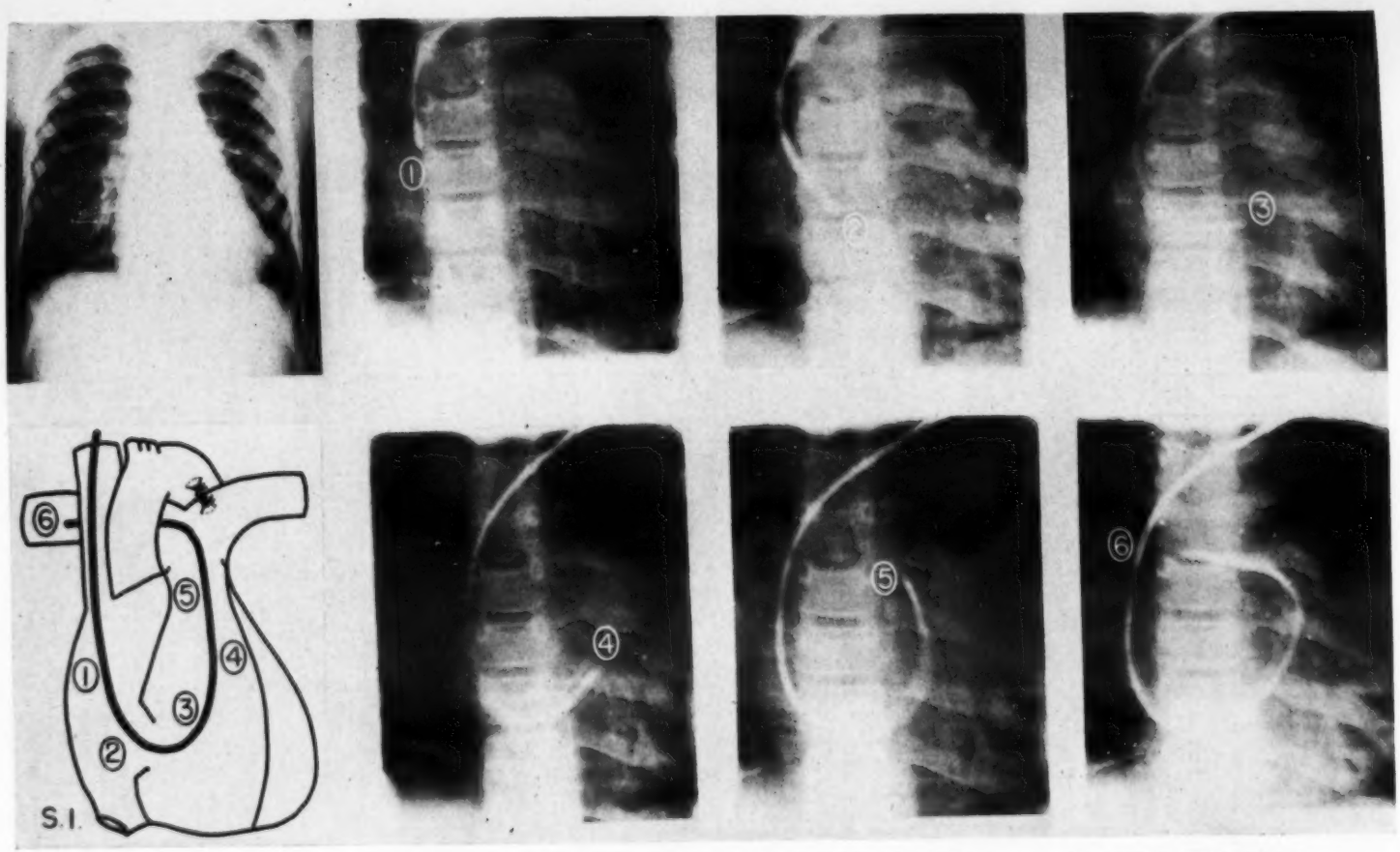

Fig. 6. Patent ductus arteriosus, after operation. The positions of the catheter are identifiable by the corresponding numbers in the schema.

that in the right ventricle, denoting the entrance of arterial blood into the pulmonary artery. Dr. Robert E. Gross explored this patient a few days later and divided a patent ductus arteriosus. Seventeen days later, venous catheterization was repeated (Fig. 6). The oxygen content of bloods obtained from the various chambers were within normal limits (Table VI). Pressures, which were high preoperatively in the pulmonary artery, right ventricle, and right auricle, had returned to normal.

SUMMARY AND CONCLUSIONS

To obtain interpretable results in congenital heart disease, venous catheterization must be performed by a well trained team of at least three persons working smoothly and efficiently, and should be used in conjunction with the usual procedures of history, physical examination, electrocardiography, fluoroscopy and, if available, the Robb-Steinberg technic (9) of visualization of the cardiac chambers with diodrast. Venous catheterization is essentially a physiological procedure, and certain of its limitations have been pointed out in this paper. Now that cure or improvement of certain congenital cardiac defects is possible by surgery, venous catheterization promises to be an important aid in preoperative diagnosis.

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The author wishes to express his appreciation to Miss Barbara Jacobs for her technical assistance.

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DISCUSSION

Wendell G. Scott, M.D. (St. Louis, Mo.): We have just heard the first major contribution in the diagnosis of congenital heart disease that has been brought before us in several decades. Here again is an example of the effective application of anatomic and physiologic methods to the radiographic study of heart disease.

As Dr. Sosman pointed out, catheterization of the right auricle has been an accepted technic for fifteen to seventeen years, but it remained for Dr. Sosman, Dr. Dexter, and others to develop this into a diagnostic procedure of practical clinical value. Their method brings us three things:

First, we have a probe that you can use to sound the different chambers of the heart in search for abnormal congenital foramina. This can be done under fluoroscopic guidance. Certainly it requires a skilled hand, the best of fluoroscopic assistance, but it has been amply demonstrated that it can be done—that it localizes an anatomic defect within the heart that before could not be demonstrated by any objective means.

Second, this procedure provides a method for measuring pressures within the different chambers of the heart and in the pulmonary arteries. This information can be applied to practical clinical diagnoses.

Third, this method permits us to remove samples of blood from the various chambers of the heart and determine whether or not the blood is venous or arterial, and if it is arterial, whether it is in the correct chamber.

I was also impressed by the fact that this method has been developed in a center for the study of congenital heart disease and was stimulated largely by the desire of the surgeons to obtain a more accurate diagnosis in congenital heart disease, to determine where the defect was and whether or not it was operable. I do not know the number of people with congenital heart disease in the United States, but

there must be many. What percentage of these people we can help we do not know, but certainly many have been already rehabilitated.

From personal experience, I have very little to offer. In 1934, with Dr. Warren Cole, we fed a catheter in the right auricle in an effort to introduce opaque solutions into the cardiac chambers. None of our patients complained of any subjective symptoms. At that time we did not realize the possibilities of using the catheter as a probe to seek out an abnormal foramen, which is the contribution here.

Technically, I would like to ask Dr. Sosman if the catheter is introduced into the basilic vein through a trocar or fed directly through the vein. Second, I am interested in the translucent mattress described for the radiographic table.

Also, I would like to emphasize here, as both Dr. Sosman and Dr. Dexter have pointed out, that this work was done by a team: a radiologist, an internist, a surgeon, a chemist, and a physiologist, all working together to perfect a better method for the diagnosis of congenital heart disease.

I do not feel that their percentage (13 per cent) of failures is significant when we realize that they were developing a new technic, and I presume many of their patients were children, who are difficult to handle.

In closing, I want to say that I am much impressed by the thoroughness with which the work has been done and by the clinical applications that have been brought out. I am wondering if it is advisable for us, as radiologists, to make these examinations unless we have groups of men in our hospitals who can do something with the information after it is given to them. In other words, if the surgeons are not trained to do the operative procedures on the heart, perhaps it would be best to defer such examinations to a team that is functioning and that is associated with cardiac surgeons.

Leo Rigler, M.D. (Minneapolis, Minn.): Anyone who has had to examine cases of cyanotic heart disease to determine whether or not the patient is a candidate for the Blalock operation will, I am sure, fully appreciate the value of the procedure that Dr. Sosman and Dr. Dexter have outlined.

The crux of that problem—which has certainly plagued us, at least, to the greatest degree—is whether or not the patient really has a pulmonic stenosis; that is, whether one is dealing with an adequate circulation of the lungs; whether there is a real tetralogy of Fallot or an Eisenmenger defect or, as in one of the cases Dr. Sosman showed, there is a tetralogy with a pre-existing patent ductus, which of course would make the operation unnecessary; or whether, as in some cases, there is a tetralogy with a collateral arterialization of the lungs to such a degree that the operation may be unnecessary.

That is a problem that we have had almost no success in solving by ordinary means. I wonder if Dr. Dexter would say a word about the utility of this procedure for its solution.

Merrill C. Sosman, M.D. (*closing*): I would like to thank Dr. Scott for his generous discussion. I will try to answer some of his questions and will leave the others to Dr. Dexter.

Originally the catheter was passed through a hollow needle, but the catheter would occasionally catch on the point of the needle and, after the first few times, that practice was abandoned. The catheter is now passed directly into the vein itself.

The mattress is ordinary sponge rubber, 4 cm. thick, and does not seriously interfere with fluoroscopy or spot filming.

It is important, I think, to emphasize that the fluoroscopy should be under the control—or at least the guidance and supervision—of someone acquainted with the dangers of fluoroscopy. That has not been pointed out as far as I know in any of the papers on this subject so far. We try to limit fluoroscopy to as small a field as possible and try to make it intermittent, so that there is no excessive exposure of any one part. As you can readily see, the field is moved around from place to place as the tip of the catheter is advanced or withdrawn.

Spot films, ordinarily six to eight in an individual case, add very little to the danger of overexposure. It would be wise to have an automatic recording time-clock in the circuit so that the operator would know exactly how much exposure has been given, calculating in advance what the maximum safe exposure can be.

The 13 per cent failures mentioned by Dr. Scott were in the first hundred cases and I am sure the percentage dropped considerably in the second half of those hundred cases as we acquired facility.

I think Dr. Scott also emphasized a very important thing: that methods as a rule are developed to meet a demand. There has been a demand for estimation or recording of pulmonary pressures before this, but not a particularly vigorous demand, mostly from the physiologists. Here is a critical situation when the surgeons say, "Shall we operate or shall we not?"

Cardiac surgery has reached such a degree of development that some method of more accurate preoperative determination of the exact status was imperative, and this I think has met that demand to a large extent, though not yet entirely. It is complementary to the other methods, such as the Robb-Steinberg technic, the routine methods of physical examination, and fluoroscopy.

Lewis Dexter, M.D. (*closing*): It is necessary to evaluate patients in the usual way, on the basis of history, physical examination, electrocardiography, and fluoroscopy. Unless the operator has a pretty fair idea, ahead of time, as to what defects he is looking for, he may very well overlook on routine venous catheterization one or more of the abnormalities present.

The Robb-Steinberg technic, of course, should not be considered as an alternative to venous catheterization, but as a complementary study. It gives information of a different sort. Venous catheterization is essentially a physiological technic. The Robb-Steinberg method is essentially an anatomical method, and the two go hand in hand.

I agree with Dr. Scott that this technic will never become an office routine. It will be confined pretty much to those centers where there is an interest in congenital heart disease and where cardiac surgery is being practised. There are many hospitals that are setting up the technic with this point in mind, *i.e.*, as a preoperative diagnostic procedure.

Dr. Rigler has asked if Eisenmenger's complex (where there is no pulmonary stenosis) can be differentiated from the tetralogy of Fallot (where pulmonary stenosis is present). In the former, the Blalock operation is not indicated; in many of the latter, it is. The presence or absence of pulmonary stenosis can be recognized accurately by venous catheterization and, I think, this method is valuable in differentiating these two groups. I do not believe, however, that there is clear-cut differentiation between Eisenmenger's complex on the one hand and the tetralogy of Fallot on the other. There appears to be a whole spectrum between the two extremes. We have studied a number of patients, mostly adults, who have appeared to be in perfect circulatory balance with a moderate degree of pulmonic stenosis and with a reduced pulmonary blood flow, but not enough, in our opinion, to justify the Blalock operation. Bing, in Baltimore, has studied many tetralogy patients and has used respiratory methods as well as venous catheterization for the determination of pulmonary blood flow. Using these technics, he has been able to obtain information with regard to the amount of collateral circulation through the lungs. Venous catheterization alone gives a fairly accurate indication of the amount of blood flowing through the pulmonary artery but gives no information concerning the collateral circulation. I believe it is fair to say that information derived from a successful catheterization is sufficient to make an accurate diagnosis of the tetralogy of Fallot.

Cholangiography and Biliary Regurgitation[1]

LEO G. RIGLER, M.D., and HARRY W. MIXER, M.D.

University of Minnesota, Minneapolis, Minn.

CHOLANGIOGRAPHY, the roentgen study of the biliary tract by means of the direct introduction of a contrast medium, may be accomplished in a number of ways and with a number of contrast substances. The material may be injected directly into the gallbladder or the common duct—immediate cholangiography—at the time of a surgical exploration of the biliary tract. Roentgenograms are then made on the operating table (Fig. 1). More commonly the injection is made postoperatively through a drainage tube previously inserted into the gallbladder or the common duct—delayed cholangiography.

Recently some efforts have been made to inject a radiopaque substance into the gallbladder before operation. This can be accomplished by either of two procedures. A catheter can be placed in the gallbladder through a simple abdominal incision. Cholangiography is then done and the situation of the biliary tract determined (Fig. 2). The information obtained will govern the exact type of surgery to be undertaken. Another method is that suggested by Horan (1) and Marcel Royer (2). Under the guidance of a peritoneoscope introduced into the peritoneal cavity, a needle is thrust into the gallbladder and the biliary tract is thus injected with the contrast medium. Roentgenograms may then be obtained and the presence or absence of calculi, strictures, tumors or other abnormalities may be determined.

In the first attempts at cholangiography, Carnot and Blamoutier (3) used a barium suspension as a contrast medium but the medium was unsatisfactory, so the effort was unsuccessful. The first satisfactory result was accomplished by Lanari and Squirru (4), using lipiodol. A clear delineation of the major biliary ducts was obtained. This medium is still used by many radiologists, notably in South America. In this clinic, iodized oil as a contrast medium for cholangiography was abandoned many years ago because of its viscosity, its tendency to form globules, and the uneven distribution which resulted (Fig. 3). Following this we used thorotrast (thorium dioxide sol), finding it a most satisfactory substance because of its great opacity to x-rays and its ready miscibility with aqueous solutions. An unfortunate experience led us to discontinue its use. A patient, in whom a tube had been placed in the common duct during the course of a cholecystectomy, was given an injection of thorotrast through this opening. The

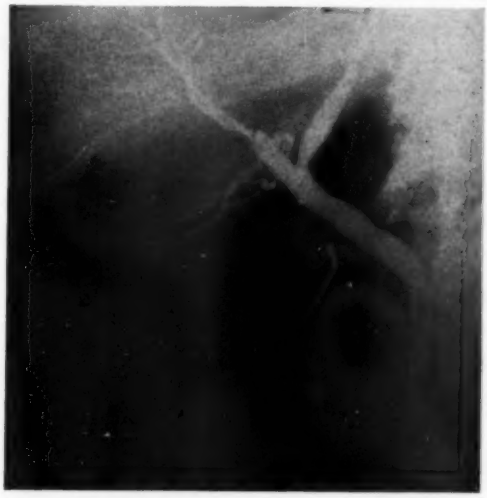

Fig. 1. Immediate cholangiogram. At operation the bile ducts were injected through a cannula in the cystic duct. Even though the surgical specimen of the gallbladder contained stones, the surgeon was assured by the series of cholangiograms that none was present in the biliary ducts. Hence it was not necessary to explore the common duct nor to drain it postoperatively.

[1] From the Department of Radiology and Physical Therapy, University of Minnesota. Part of a thesis presented in partial fulfillment of the requirements for the degree M.S. in Radiology by Dr. Harry W. Mixer, Trainee, National Cancer Institute. Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

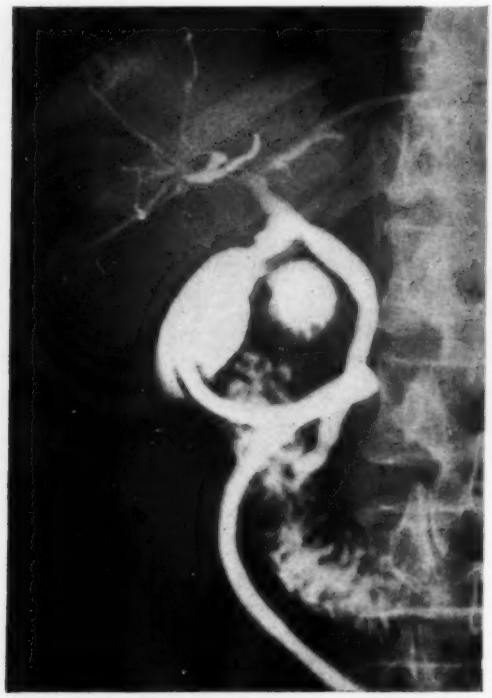

Fig. 2. Injection of biliary system through cholecystostomy tube. The tube is seen extending into the gallbladder. Both the intrahepatic and extrahepatic portions of the biliary tree are filled. The entire duodenum is also visualized. Preoperative injection of the gallbladder under peritoneoscopic control would produce the same type of filling.

tube, however, had been diverted from the duct and the inner end was lying in the peritoneal cavity. The contrast medium was therefore introduced into the peritoneal space. The result was a violent reaction, high fever, and evidences of peritoneal irritation. Recovery eventually occurred, but the thorium dioxide remained in the sinusoids of the peritoneum and in the lymph nodes for many years. Since the material may possibly be carcinogenic when introduced directly into subcutaneous or subserous tissues, we have felt it unwise to use it when there was even a remote possibility that it would not be readily excreted.

Since 1939, we have used organic iodine compounds, most commonly diodrast, for cholangiography. Such substances can be used in variable concentration, are readily

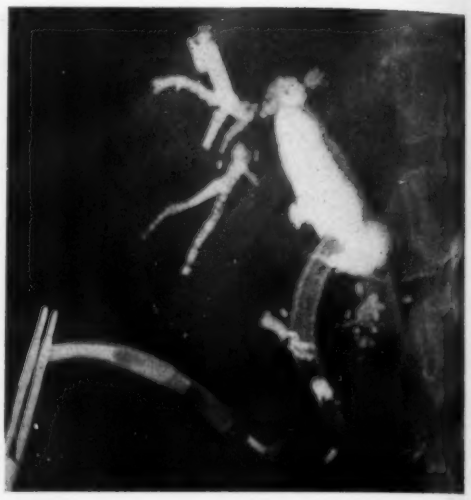

Fig. 3. Lipiodol cholangiogram. There is poor filling of the ducts. The medium tends to form droplets of various sizes because it is not miscible with bile. The smaller biliary radicles are not filled because lipiodol is too viscous.

miscible with bile giving a uniform opacity, are relatively non-irritant, and are quickly absorbed and readily excreted through the kidneys if introduced outside the biliary tract.

About six years ago an interesting observation was made by one of us in several cases, an observation concerning which we have found no mention in the literature. It was noted on some of the roentgenograms of the biliary tract made fifteen to thirty minutes after the injection of diodrast that not only was the biliary duct system visible but also one or both of the kidney pelves could be seen (Figs. 4–6). It was apparent at once that this phenomenon of excretion of the dye through the kidneys following cholangiography occurred only in cases with partial or complete obstruction of the common duct. The terminal hepatic radicles appeared well distended, and little or no dye was found in the intestine.

Recently the films of 126 patients on whom cholangiography was done since 1939 have been reviewed to determine the frequency of the appearance of the contrast medium in the kidneys. There were 460 individual cholangiographic studies in this

series, since in many cases several examinations were made. A total of 8 cases were found in which the kidney pelves were clearly delineated. In all of these there was partial or complete obstruction of the distal portion of the common bile duct due to stone. No case was found without such obstruction.

Kidney excretion of diodrast used in cholangiography probably occurs more frequently than the above data indicate. The kidney shadows are commonly hidden by gas, fecal material, or contrast medium in the bowel overlying the kidneys. Likewise small quantities of the dye might be overlooked. Consequently an optimum

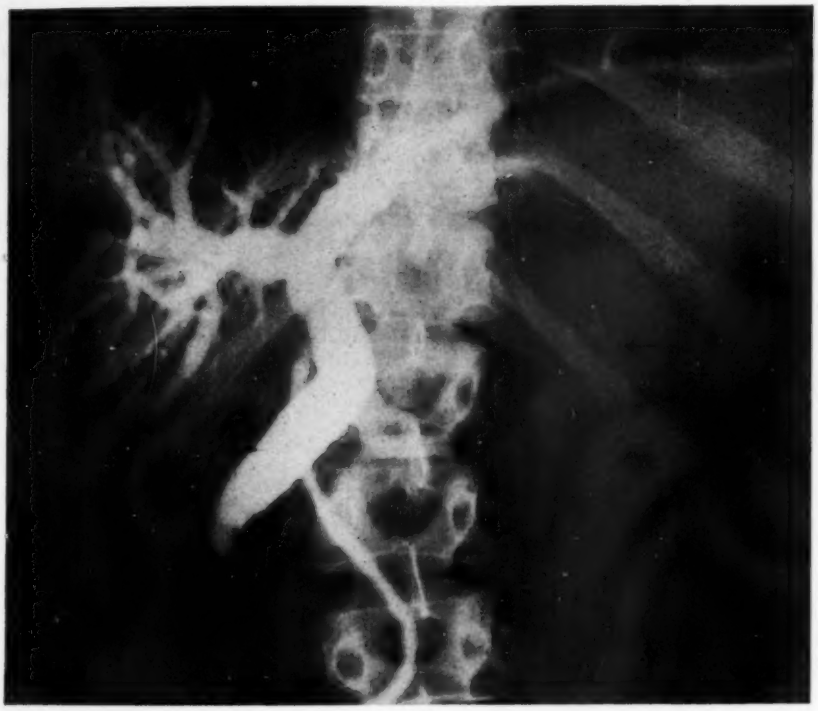

Fig. 4. Regurgitation of contrast medium. Case 1: Film made on June 10, 1941, fifteen minutes after injection. There is obstruction of the distal common duct, allowing no contrast medium to pass into the bowel. The duct system is dilated and well filled. Contrast medium is seen in the calices and pelvis of the right kidney and in the calices of the left kidney (arrows).

In several of our cases on which multiple cholangiographic studies were made, the kidney pelves were filled with dye during one study but not during another. In both instances the ducts appeared to be well distended. The kidney shadows could be well visualized and were not hidden by gas or other confusing shadows. The lack of visualization in some studies probably indicates that sufficient pressure was not applied during the injection of the common duct to cause regurgitation from the biliary radicles into the blood stream.

set of circumstances must prevail if this phenomenon is to be observed.

Three possible explanations may be considered for the findings described above. The dye might conceivably be absorbed from the intestine and then excreted. The presence of obstruction and the absence of dye shadows in the bowel would contravene this explanation. A second possibility is that the dye is absorbed into the blood stream from the mucous membrane of the biliary tract and then excreted through the kidneys. If simple absorption

of the diodrast by the bile-duct mucosa plays an important part in this phenomenon, then the dye should gain access to the blood stream and the kidneys in every cholangiogram with good filling of the duct system. As already indicated, kidney filling can be demonstrated in only a very small percentage of cases with good duct filling. Moreover, in several of our cases demonstrating this regurgitation phenomenon, the dye could be seen in the kidneys as early as fifteen minutes after the injection and in one case as early as five minutes. It does not seem likely, if simple absorption were the important factor, that the iodine compound would reach the circulation and the kidneys so rapidly. Shafiroff and Bierman (5) have published experimental data which are of interest in this regard. After ligating the cystic duct in cats and preserving the gallbladder lymphatics and vessels, they injected various radiopaque substances into the lumen of the gallbladder. Crystalloidal substances such as diodrast, skiodan, sodium iodide, and uroselectan were found to be absorbed in six hours and were demonstrated in the kidneys several hours later. Although this represents absorption by the gallbladder rather than by the biliary ducts, it would seem reasonable to believe that there would be even less absorption by the ducts than by the viscus. In all of our clinical cases the gallbladder had been eliminated from the system. Therefore, the fact that we have demonstrated dye in the kidneys in a matter of minutes following the injection would speak against simple absorption as an important factor in producing the kidney shadows in our cases.

The most likely possibility lies in the phenomenon of biliary regurgitation. An understanding of the pressures involved within the biliary duct system is necessary before the reasons for various types of cholangiographic duct filling become apparent. Various investigators have made measurements of the average normal pressures found within the human biliary duct system. According to Doubilet (6) the average maximum secretory pressure of the liver is 350 mm. water. The normal resistance of the sphincter of Oddi is 150 mm. water, and the maximum contracting force of the gallbladder is about 250 mm. water. This would indicate that under normal conditions the sphincter of Oddi could be forced open by the gallbladder contraction. Under normal physiological conditions, however, the sphincter relaxes simultaneously with the contraction of the gallbladder. In addition, bile cannot ordinarily be forced up the hepatic ducts against the higher secretory pressure of the liver by the contracting gallbladder. Normally the gallbladder maintains about 100 mm. of pressure within the duct system. Under conditions of normal sphincteric resistance, when the contrast substance is injected into the common duct, it usually empties through the ampulla into the duodenum without good filling of the hepatic ducts and especially the smaller biliary radicles. Under such normal conditions it is difficult to study the proximal portion of the common duct and the hepatic ducts because of the poor filling. Consequently, morphine should be given the patient before the injection of the dye if one is to obtain good filling of the proximal portions of the duct system in the absence of increased resistance in the distal portion of the common duct. In one of Doubilet's cases, the normal sphincteric resistance was 150 mm. water. Following the administration of morphine, it required a pressure of 370 mm. water to open the ampulla. Similarly in cases with obstruction in the distal common duct, such as stricture, spasm, or stone, it is much easier to obtain a good filling of the proximal ducts because this obstruction of the distal duct makes it possible to apply pressure equal to or above the hepatic secretory pressure. In some cases there is good filling of the hepatic radicles in spite of apparently rapid emptying into the duodenum. This indicates that, previous to the making of the film, there was some increased resistance at the ampulla which allowed dye to be forced in a proxi-

mal direction followed by relaxation of the spasm, permitting dye to pass into the duodenum. This might occur with injection of cold material causing spasm at the ampulla followed by relaxation as the material became warm.

During the past 150 years there have been much discussion, theorizing, and experimentation concerning the route of regurgitation of materials from the biliary system into the general circulation. Some have held that regurgitation takes place directly into the hepatic sinusoids and hepatic veins, while others believe that regurgitation occurs chiefly through the hepatic lymphatics and the thoracic duct. A third group believes that either route may be followed, depending upon the stage of obstruction and the amount of pressure applied. The latter concept has been generally accepted by most recent investigators.

This entire concept has been well summarized by Rich (7) as follows: Each hepatic sinusoid is lined by a continuous endothelial membrane which separates the sinusoid from the lymph space surrounding each hepatic lobule. Normally the endothelium lies close to the liver cells. When the liver cells become atrophic and shrink away, it is easy to demonstrate this lining. Rich believes that the fact that, in early obstructive jaundice, bile pigment appears in the lymph earlier than in the blood stream is itself evidence that the lymph space is separated from the blood by a complete lining. Bile under beginning pressure, then, apparently passes first into the adjacent lymph space by diffusion, with only slight diffusion through the

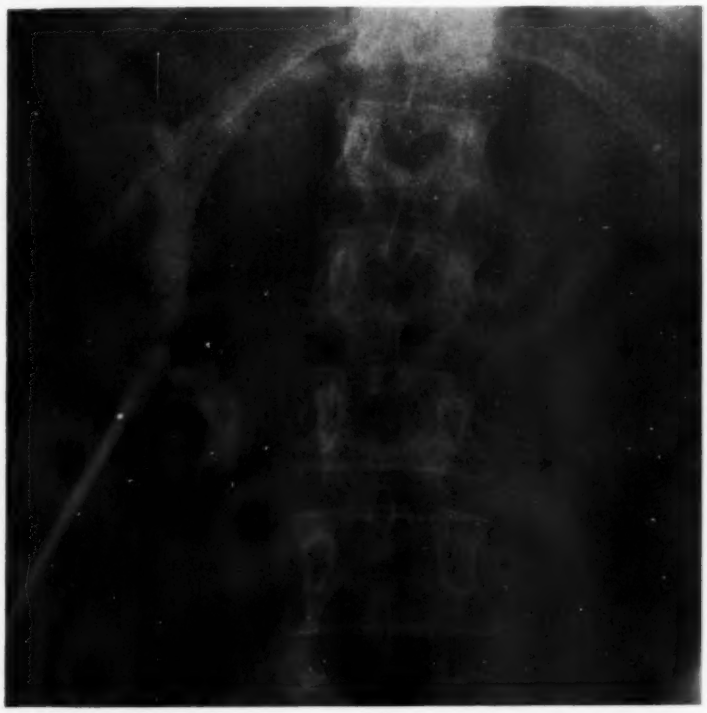

Fig. 5. Regurgitation of contrast medium. Case 2: Film made on Aug. 29, 1944, fifteen minutes after injection. A stone can be seen obstructing the distal common duct. Little or no dye is seen in the bowel. The calices of the right kidney and the calices, pelvis, and upper ureter of the left kidney are well delineated (arrows).

endothelium into the hepatic sinusoids. In later stages of obstruction, with higher pressures being applied to the duct system, many of the canaliculi actually rupture, allowing the contents to spill freely into both the lymph spaces and hepatic sinusoids directly.

From the above considerations, it appeared most likely that we were dealing with a process of regurgitation of the contrast medium into the blood stream as a result of the pressure applied. Further studies, as yet unpublished, have since been made on animals under controlled conditions, with diodrast, thorotrast, radioactive phosphorus and bacteria, all of which establish this explanation unequivocally.

The significance of this observation is twofold. It tends to establish firmly the correctness of the theory that regurgitation of substances in the biliary tract into the blood stream may occur if sufficient pressure is exerted. In addition, it affords a new explanation for the reactions which occasionally attend cholangiography.

It is not uncommon to observe mild or even severe febrile reactions after injection of the biliary tract. It has been noted that such reactions follow only in cases with biliary tract infections. The demonstration of regurgitation of contrast medium during cholangiography suggests a possible explanation for such reactions. If contrast medium can be regurgitated into the blood stream, it seems reasonable to believe that bacteria present in the biliary system could be forced into the blood stream as well. Recent experimental work carried out on dogs in our laboratory indicates that this is true. Details of this work will be reported later.

Some investigators have suggested that simple dilatation of the biliary radicles is the cause of reactions. In none of our 8 cases with regurgitation into the blood and kidneys was there any report of reaction either mild or severe. The biliary system in all 8 cases was obviously distended. However, in no case was there any evidence of biliary tract infection. The absence of bacteria in the bile ducts would decrease the chance of any bacteria being forced into the blood stream. This probably explains the absence of reactions in the presence of obvious regurgitation.

Others, such as Mallet-Guy (8), have attributed severe reactions following cholangiography to regurgitation into the pancreatic duct. Bergh (9) of our clinic, however, recently studied a series of cholangiograms and found that the pancreatic duct was filled in about one-third of these. Reactions following cholangiography occur only in a small fraction of this percentage, which would seem to indicate that this duct filling is probably not the explanation for reactions.

Since the possibility of forcing material from the biliary tract directly into the blood stream exists, it seems obvious that great care should be exercised in doing cholangiography. Pressures should be kept at as low a level as possible consistent with reasonably good filling of the intrahepatic ducts. In all probability, fluoroscopic control should be utilized to permit the use of a minimal degree of pressure. Furthermore, as much asepsis as possible should be observed.

Three cases will be reported in detail to illustrate the observations recorded above.

CASE 1 (29-year-old female): On entering the hospital, the patient complained of attacks of right upper quadrant pain, fatty food distress, and jaundice during the past three years. Laboratory tests indicated common duct obstruction. At laparotomy, April 30, 1941, a stone was found in the common duct near the ampulla. Two stones were present in the gallbladder. Following cholecystectomy and probing of the common duct, a small catheter was sutured into the cystic duct.

Subsequent to surgery, the tube could not be clamped without drainage around it. Cholangiograms made May 14 and June 10, 1941, revealed a stone in the distal common duct with dilatation of the hepatic and common ducts. On the latter examination, the phenomenon of contrast medium in both kidney pelves was observed on the films made fifteen and forty-five minutes after the common duct injection. Figure 4 shows the fifteen-minute-film.

On June 13, 1941, re-exploration revealed a stone, which was removed from the distal common duct. On July 17, 1941, a repeat cholangiogram revealed no residual common duct stones.

There was no evidence of reactions following any of these common duct injections. The patient apparently was free from cholangitis.

CASE 2 (48-year-old female): The patient's chief complaints on entering the hospital were jaundice and right upper quadrant pain of three months' duration. An x-ray film of the right upper quadrant on May 25, 1944, revealed numerous calcified gallstones and a single calcified stone in either the cystic or the common bile duct. Laboratory tests indicated obstruction of the common bile duct. At surgery, on June 15, 1944, seven stones were removed from the common duct and five from the gallbladder. A T-tube was placed in the common duct and left for drainage. Following surgery, the patient was not able to clamp the drainage tube without distress. Cholangiograms on Aug. 18 and Aug. 29, 1944, revealed stones in the common duct. On the latter examination, in addition, contrast medium could be visualized in both kidneys on the film made fifteen minutes after the injection of the common duct. Figure 5 is a reproduction of this film.

Repeat laparotomy on Aug. 31, 1944, revealed in the distal common duct a single large stone, which was removed. An immediate cholangiogram during surgery showed no evidence of common duct stone. A cholangiogram on Sept. 14, 1944, indicated the common duct to be normal.

There were no reactions following any of the common duct injections and no evidence of cholangitis.

CASE 3 (44-year-old female): The patient's chief complaints on entering the hospital were right upper quadrant pain, chills, fever, jaundice, night sweats, nausea and vomiting, dark urine, and acholic stools for several months. Laboratory tests indicated obstruction of the common bile duct. A cholecystogram on Jan. 9, 1945, was interpreted as representing a non-functioning gallbladder. On Jan. 25, 1945, laparotomy was carried out. Multiple stones were found in the gallbladder and two were present in the cystic duct. A T-tube was left in position in the common bile duct.

On Jan. 25, 1945, a cholangiogram immediately following surgery indicated that a stone was still present in the distal common duct. The bile ducts were dilated considerably. On Feb. 5, 1945, a cholangiogram revealed the same findings. In addition, the phenomenon of filling of both kidney pelves was evident on the films made twenty-five minutes

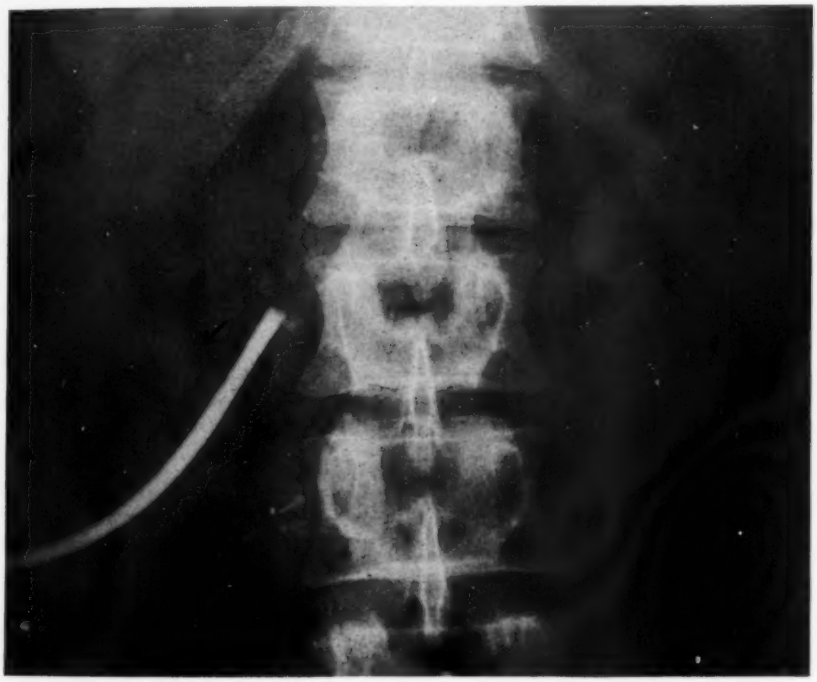

Fig. 6. Regurgitation of contrast medium. Case 3: Film made on June 14, 1945, thirty minutes after injection into the common duct. The kidney structures are very well delineated bilaterally (arrows), indicating that a large volume of contrast medium must have gained access to the blood stream. The picture compares with that produced during the usual excretory pyelogram.

after the common duct injection. The dye could not be visualized in the kidneys on the fifteen-minute film in this case, however. Cholangiograms on Feb. 15 and March 7, 1945, again indicated the common duct stone and dilated ducts, but no contrast medium was demonstrable in either of the kidneys, which should have been easily visualized if it were present. A cholangiogram made on June 14, 1945, demonstrated two stones in the distal common duct and dilatation of the ducts. On the thirty-minute film dye could again be seen in both kidney pelves. This is demonstrated in Figure 6. On June 26, 1945, two stones were removed from the common bile duct. Immediate cholangiography during surgery indicated that all of the stones had been removed.

There were no reactions following any of these common duct injections; neither was there any indication of cholangitis, which probably explains the absence of reactions.

SUMMARY AND CONCLUSIONS

The observation of the excretion of organic iodine compounds through the kidneys after injection into the biliary tract is recorded.

Such excretion appears to occur uncommonly, being observed in 8 cases out of a series of 460 cholangiograms.

It is invariably associated with obstruction of the common duct.

The evidence indicates that the contrast medium finds its way into the blood by regurgitation through the liver. The phenomenon of biliary regurgitation is thus further established.

It is probable that the reactions following cholangiography are due to a transient bacteremia rather than to distention of the bile ducts. In doing cholangiography, therefore, care must be exercised to keep the injection pressure low enough to avoid the danger of regurgitating bacteria or other foreign material into the blood.

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DISCUSSION

Walter Palmer, M.D. (Chicago, Ill.): As an internist primarily interested in the digestive tract, I must confess to a great weakness for the roentgenologic method. I do not need to apologize for that weakness to this particular audience. X-ray is the easiest, most available, most convenient, and most practical method available for the study of the digestive tract, particularly in man.

The paper just presented shows the way in which the experimental and clinical approaches to a problem may be combined. It also illustrates the way in which a prepared mind may make a very significant observation in the course of a routine study. Dr. Rigler and Dr. Mixer were astute enough to notice, in this rather large group of cholangiograms, that under certain circumstances the renal pelvis was visualized. It seems to me they made the correct deduction from that and set to work to verify it experimentally.

I see no escape from the conclusion they have drawn with regard to the significance of their observation and the so-called regurgitation phenomenon in jaundice. They have shown definitely and conclusively that the dye can be absorbed from the biliary tract and rapidly excreted into the kidney. The speed with which this takes place seems to indicate regurgitation from the biliary canaliculae directly into the blood stream through the blood sinusoids in order for the dye to be excreted by the kidney in the time in which it is excreted. Of course it may be, also, that the dye escapes from the biliary canaliculae into the lymphatics, but lymphatic escape alone would apparently not explain the rapid excretion of such large amounts of dye into the kidney pelvis.

I should like to congratulate the authors of this paper on their splendid presentation.

Lewis Allen, M.D. (Kansas City, Kans.): I should like to take a moment to raise the question of the use of diodrast and iopax in cholangiography. I am stimulated to ask this question on the basis of: "Shall we do sensitization tests on patients in whom cholangiograms are contemplated?"

One objection to the use of lipiodol is the pressure necessary to inject the common duct tube by the T-

tube. Very recently a patient—a surgeon brother-in-law of mine—wandered afar and had a common duct stone removed. His surgeon wished to know the caliber of his common duct. I did a cholangiogram, using lipiodol. He objected, due to the pressure necessary and asked that I instill 5 c.c. of neo-iopax by gravity. I did, and I did not precede it by a test for sensitivity. The patient suffered a tremendous reaction, with a fearful outpouring of bile, shock, and prostration.

I wonder, then, if cholangiograms are to be made routinely by the use of diodrast or neo-iopax, whether we shall also employ some test of sensitization to iodine, and, if so, what would be considered a reliable test. I should like to ask Dr. Mixer to comment on this point.

Merrill C. Sosman, M.D. (Boston, Mass.): I think some difficulties would be or could be avoided if fluoroscopy were used routinely during the injection. I should like to ask Dr. Mixer if that is part of his procedure. It certainly is of ours.

I would call attention to the very first film shown where dye had been injected—I presume in the operating room—which was said to show a perfectly normal duct so that the surgeons knew there was no stone present. This is an entirely erroneous conclusion, for any number of small stones could be obscured by a common bile duct which was as well filled as that one was.

If the injection is done under fluoroscopic control, you can see the duct being filled and, as in the case of a small foreign body or small tumor of the esophagus, the opaque dye will first go around it and then cover it up. Serial spot films may be taken as the common duct is being filled, and at the same time you will avoid any increased pressure which may cause this regurgitation of dye into the biliary tract.

This next is an entirely different subject but a parallel circumstance occurs, which I have run across twice. I would like to call your attention to it, and I'm sure that, if it is called to your attention, many of you will see it, also. This occurrence Dr. Mixer has reported happens only when there is obstruction of the common duct, as I understand it. If in the use of priodax to outline the gallbladder there is obstruction to the renal outflow on the right side—in other words, a hydronephrosis of the right kidney—you may get a similar filling of the right renal pelvis from the priodax test and that shadow—if the renal pelvis is nice and round and its calices are not too definite—may simulate exactly a normal gallbladder. Thus we have, as you see, the exact parallel set of circumstances, except that the things are reversed. I have seen this happen twice, and I am sure some of you may have seen it, also.

I should like to congratulate Dr. Rigler and Dr. Mixer on their very excellent paper.

Leo G. Rigler, M.D. (*closing*): On the question that Dr. Allen raised, I may say that we have never seen what we would consider a diodrast reaction or an iodine reaction after cholangiography. This is over a period of about six years, and I am not aware of any such reactions reported in the literature. We have seen reactions, as Dr. Mixer said, but these were febrile, not the usual type of allergic reaction that one gets after intravenous introduction. As a matter of fact, we do not use testing even in intravenous urography, so we obviously would not in this situation and I really don't know what we would do about it. We have no confidence in pre-intravenous sensitization tests.

What Dr. Sosman says is, of course, quite correct. I think Dr. Mixer passed rather rapidly over that one film merely as an illustration of what an immediate cholangiogram would look like. We usually have several films—one with the duct partially filled and one with it fully filled. The delineation of the duct was a little better, because it was fully filled, but judgment is made on more than one film.

There is no doubt, however, that Dr. Sosman's statement to the effect that fluoroscopic control might avoid a certain amount of difficulty is correct. Nevertheless, one must bear in mind that if you want to fill the biliary ducts, a certain amount of pressure above the secretory pressure of the liver has to be exercised. Of course, if one only wishes to fill the extra-hepatic portion of the common duct, it might be possible to accomplish this without much pressure. But in many instances, especially in patients in whom there is already an obstruction of the distal end of the common duct, some pressure must be applied, and even under fluoroscopic control I have no doubt that one would produce the amount of pressure which would lead to this regurgitation phenomenon. That is what happened in the dogs that Dr. Mixer worked on, and the amount of pressure needed to produce the excretion was really very small, so that I doubt whether fluoroscopic control would eliminate that in every case.

I might add to Dr. Sosman's parallel—that is, the injection of diodrast during retrograde pyelography into one kidney and getting it seen in the other kidney by way of a pyelovenous reflux, is a somewhat similar situation.

Epipericardial Fat Shadows in Differential Diagnosis[1]

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Ann Arbor, Mich.

As any one who has seen an appreciable number of autopsies can testify, the accumulation of sizable quantities of adipose tissue outside the pericardium of obese individuals is a commonplace occurrence. It is also common knowledge that these epipericardial fat pads frequently are visible roentgenologically along the left heart border, at times completely obliterating the left cardiophrenic angle. What is apparently not so widely recognized is the fact that large extrapericardial fat deposits occasionally produce well defined roentgenographic shadows adjacent to the right heart border. In this location they sometimes present particularly difficult diagnostic problems.

The literature on the subject of pericardial fat is widely scattered and surprisingly meager. As long ago as 1910, Schwarz (1) described the frequent fluoroscopic observation of triangular shadows of increased density obscuring the left cardiophrenic angle in some of his obese patients. Because these shadows were less dense than that produced by the heart itself, Schwarz concluded that they represented fat tissue, a fact which he repeatedly confirmed at autopsy.

A few additional references to Schwarz's observations followed (2, 3, 4), and then, in 1936, McGinn and White (5) re-emphasized the importance of recognizing epipericardial fat deposits to avoid errors in roentgenologic estimation of heart size. During the same year, Kautz and Pinner (6) stated that "after reviewing a large roentgenologic material and evaluating the very few observations in the literature, we reached the conclusion that under certain circumstances extrapericardial fat bodies may be visualized roentgenologically." These authors then presented the roentgenologic and anatomic findings in a patient with prominent fat shadows at both cardiophrenic angles and listed some of the intrathoracic conditions with which these fat bodies might be confused.

Our current interest in right epipericardial fat deposits is largely centered around the problem they present in photofluorography. The opportunity to view literally thousands of chest roentgenograms afforded by the increasingly popular mass survey methods employing miniature film has made the roentgenologist acutely aware of a number of insignificant normal variations in the appearance of intrathoracic structures. At times, some of these findings are extremely difficult to distinguish from clinically important lesions. The wide anatomic and physiologic variations in the size and shape of the heart, the frequent unexplained accentuation of the undivided portion of the pulmonary artery or of peripheral vascular markings in the upper portions of the lungs, and the startling prominence of the innominate artery buckled outward by a tortuous thoracic aorta, are just a few of many examples which might be mentioned. In our experience, however, no roentgenologic finding has proved more annoying or more troublesome than an occasionally encountered homogeneous shadow of increased density at the right cardiophrenic angle. This shadow may show considerable variation in size and shape, but in general it is roughly triangular or ovoid, with its outer margin well defined and somewhat convex. We believe that the majority of these shadows represent deposits of epipericardial fat, although such is not always the case.

In an attempt to gain some idea of the incidence of these confusing shadows,

[1] From the Department of Roentgenology, University of Michigan, Ann Arbor. Read before the Section on Radiology of the American Medical Association, San Francisco, July 1946.

56,000 routine admission 35-mm. photofluorograms were reviewed. This number represents approximately one-half of the admission chest films made at the University Hospital during the past five years. In 380 instances a right median base shadow meeting the above description and warranting further investigation was encountered. The incidence figure expressed in percentages (0.6 per cent) is certainly not impressive, but it should be remembered that large-scale survey methods have elevated chest roentgenography into the realm of subastronomical figures and, therefore, it is the actual number of patients found that is important.

Although it is obviously impossible to discuss the findings and final disposition of this entire group of 380 patients, several deserve particular attention from the standpoint of differential diagnosis.

CASE 1: J. M. (514222). In January 1943, a pear-shaped shadow of increased density at the right median base was found on a routine check-up photofluorogram of a University Hospital employee and was reported as a significant lesion. Subsequent fluoroscopy and 14 × 17-inch roentgenograms of the chest entirely confirmed the photofluorographic findings, showing a clearly defined tumor in the right cardiophrenic angle (Fig. 1, A). The mass pulsated, but as it was intimately associated with the right heart border, the pulsation was thought to be transmitted rather than expansile in nature. A lateral projection showed the mass to be located far anteriorly in the chest, apparently attached to the chest wall (Fig. 1, B). Its posterior border was smoothly marginated and had a well defined convexity.

The patient, a woman of 47 years, was well nourished but certainly not obese, weighing only 118 pounds. She had no symptoms or physical signs referable to the chest, and her general health was excellent. Nevertheless, exploratory thoracotomy was advised on the grounds that, for those very reasons, the operative risk was small and the chance of complete removal of a possibly malignant tumor was excellent. Accordingly, the operation was done and the tumor proved to be a lobulated mass of pale yellow *fat tissue* measuring 7 × 5 × 5 cm. The surgeon's note stated that the fat projected from the lowermost junction between the anterior costal pleura and the pericardium, being covered by the pericardial-pleural reflection. Histologic section of tissue removed at operation showed it to be "adipose tissue identifying a serous surface." The patient made an uneventful recovery, and subsequent chest films showed that the previously described shadow at the right median base had disappeared.

Comment: It is extremely gratifying to have access to this particular case. The operative findings furnish definite proof that an innocent fat deposit can be present between the pericardium and mediastinal pleura, producing a smoothly marginated shadow which, roentgenographically, has the appearance of a significant intrathoracic tumor. Furthermore, the findings in this patient provide an adequate explanation for at least some of the similar annoying roentgenographic shadows which have been observed repeatedly at the right median base in the course of photofluorography. In fact, one's initial inclination may be to dispose of all such shadows as unimportant incidental findings on the basis of a single frontal projection of the chest, thus saving both the patient and physician time and expense. In this regard, utmost caution should be exercised. Experience will show that the solution to the problem of epipericardial fat shadows is not quite so simple. This point is perhaps best illustrated by the following case.

CASE 2: M. H. (187694). This patient, a very obese woman, 63 years of age, entered University Hospital in April 1943 for treatment of hypertension. The routine admission photofluorogram showed an abnormal shadow at the median base of the right lung, and additional roentgenologic examination was requested. Regulation size films, including a lateral projection (Fig. 2, A and B), confirmed the presence of a mass which, although considerably larger, had many features in common with that encountered in Case 1. Following a negative bronchoscopic examination, the patient was given a "test of irradiation." When the tumor did not respond to moderate doses of x-ray therapy, thoracotomy was done. At operation a firm mass measuring approximately 7 × 5 cm. was found in the anterior mediastinum, lying between the mediastinal pleura and the pericardium. The Department of Pathology reported it to be "a highly malignant spindle-cell sarcoma of neurogenic origin; in other words a *neurofibrosarcoma*." Postoperative recovery was prompt and recent roentgenograms three full years following operation showed the chest to be free of significant disease.

Comment: The two patients whose case histories have been briefly summarized

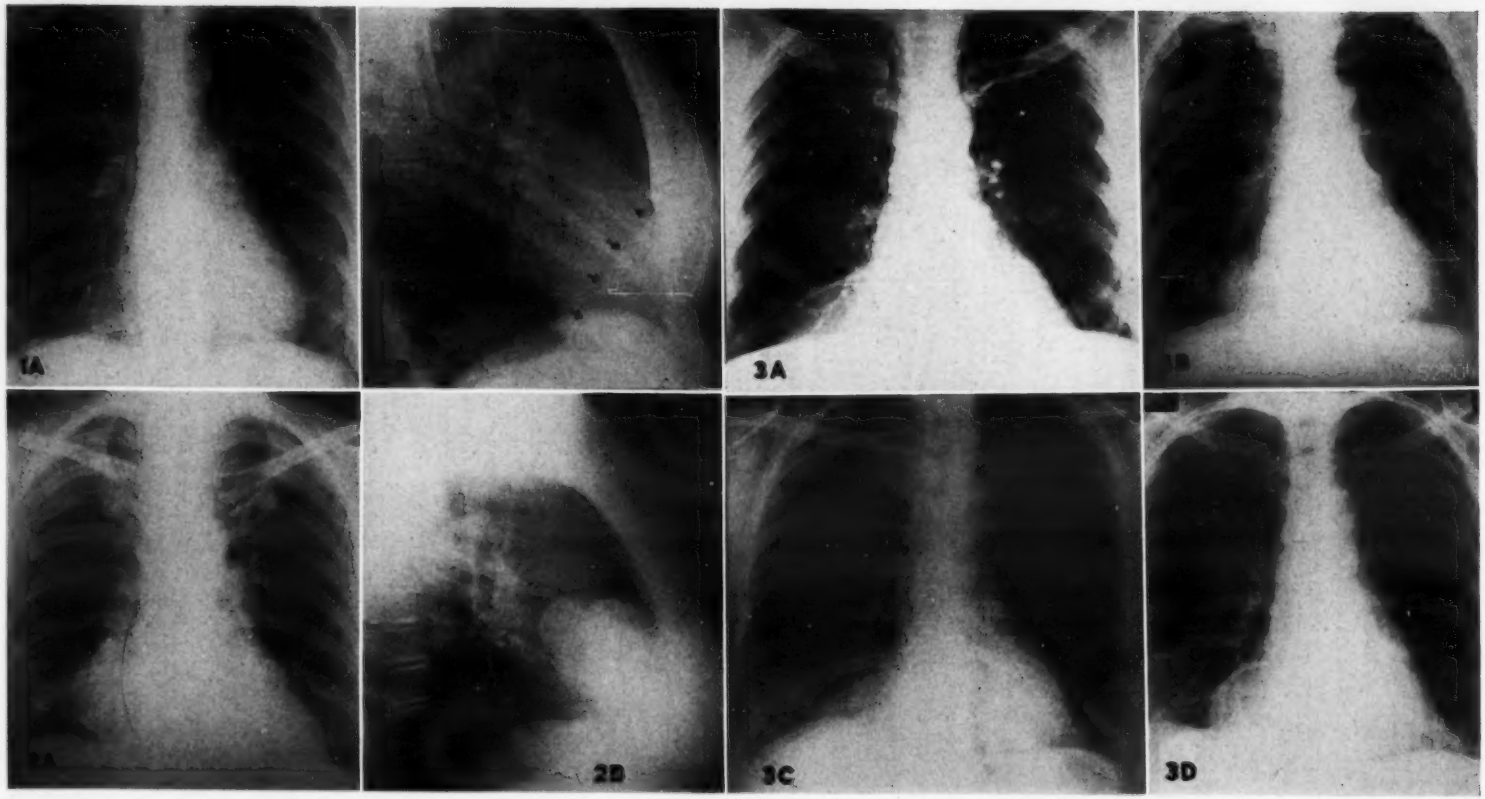

Fig. 1. Case 1. Well defined mass at right anterior cardiophrenic angle in relatively thin subject. (Postero-anterior (A) and right lateral (B) projections.) Thoracotomy proved the mass to be an *epipericardial fat deposit.*

Fig. 2. Case 2. Abnormal mass adjacent to right heart border of obese patient. Mass is similar in many respects to epipericardial fat shadow shown in Fig. 1, but at operation a *neurofibrosarcoma* was found. Patient is alive and well three years following removal of tumor.

Fig. 3. Cases 3–6. Four different cases with similar confusing shadows in right median base anteriorly. Although all of these now are thought to represent epipericardial fat pads, the original diagnosis in A was *mediastinal dermoid;* in B and C *bronchiogenic neoplasm.*

the pads, the original diagnosis in A was *mediastinal dermoid*; in B and C *bronchiogenic neoplasm*.

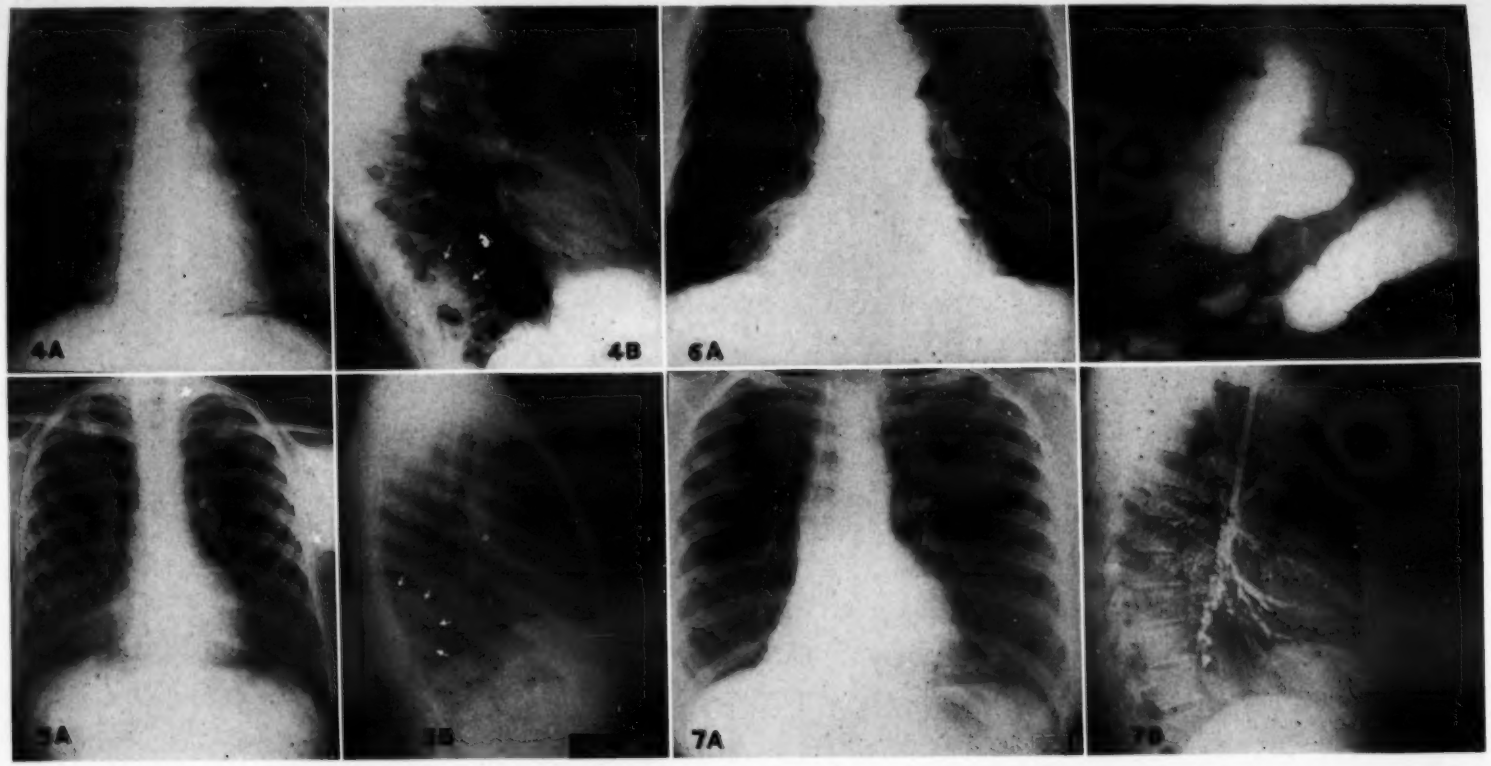

Fig. 4. Case 7. Mass at right cardiophrenic angle which in frontal projection (A) resembles fat pad shadow in Fig. 1. Lateral view (B) shows the abnormality to be in posterior portion of chest. Operation proved it to be a *tracheobronchial cyst*.

Fig. 5. Case 8. *Subpleural tuberculoma* which in frontal projection (A) closely resembles epipericardial fat deposit in Fig. 1. Lateral view (B) localized the abnormal shadow to the lower lobe region.

Fig. 6. Case 10. A. Abnormal mass at right cardiophrenic angle strikingly similar in appearance to fat pad shadow in Fig. 3, A. B. Examination of esophagus shows mass to be dilated esophagus resulting from *cardiospasm*.

Fig. 7. Case 14. Right median base shadow as seen in photofluorogram (A) was thought to be an epipericardial fat pad similar to the one on the left side of the heart. Bronchogram (B) showed the shadow on the right to represent *atelectasis* of the right lower lobe associated with bronchiectasis.

illustrate the two extremes of our problem. Further amplification of the importance of this problem to physician and patient alike is found in the two additional groups of cases which follow.

CASE 3: S. R. (391248). A 54-year-old man, 68 1/2 inches tall and 167 pounds in weight, registered on the ophthalmology service of University Hospital for treatment of defective vision. His routine admission photofluorogram, dated Nov. 23, 1942, showed a mass at the right cardiophrenic angle. Review of this man's record indicated that he had been treated at University Hospital for benign prostatic hypertrophy and pernicious anemia in 1937 and 1938, respectively. In 1939 he returned to the hospital on the thoracic surgery service because chest roentgenograms made elsewhere had shown a "lung tumor." These films were carefully reviewed, and subsequent fluoroscopy, plus frontal, lateral, and oblique roentgenograms, were obtained. All showed the mass to be at the right median base, far anteriorly in the chest (Fig. 3, A). The pulsation observed fluoroscopically was thought to be transmitted from the heart. To rule out the possibility of hepatic tumor pushing up the diaphragm anteriorly, pneumoperitoneum was done. This procedure showed the mass to be entirely within the chest, and the final roentgenologic impression was mediastinal dermoid cyst. Thoracotomy was advised but was refused by the patient.

Comparison of chest films made in 1939 and those made in 1942 shows no change whatever in the appearance of the shadow at the right cardiophrenic angle. Furthermore, the patient had no symptoms referable to his chest when last seen, Feb. 25, 1946.

CASE 4: F. C. (525043). A 68-year-old woman came to the hospital in May 1943 for treatment of a "lung tumor" which had been discovered on a preemployment chest roentgenogram elsewhere (Fig. 3, B). The patient had been refused employment on the basis of this x-ray finding despite the fact that she felt perfectly well. Her admission photofluorogram at University Hospital was supplemented by fluoroscopy and films in various projections, the final roentgenologic impression being intrathoracic neoplasm of indeterminate type. Despite negative bronchoscopic examination, operation was urgently advised, but the patient could not be convinced that such procedure was necessary. She sought medical advice elsewhere and x-ray therapy was prescribed. From July 29 to Aug. 31, 1943, she received 2,100 r to each of three 10 × 10-cm. ports directed toward the "tumor." Subsequent chest films have failed to show any appreciable change in the appearance of the mass over a period of almost three years. The patient is alive and well.

CASE 5: B. D. A 56-year-old woman had chest roentgenograms dated Nov. 5, 1943, which were made elsewhere and brought to University Hospital for review. Eleven years previously, a diagnosis of bronchiogenic neoplasm had been made on the basis of roentgenographic findings and intensive radiation therapy had been given. Previous films had been destroyed, but available reports clearly indicated that the suspected "bronchiogenic neoplasm" was located at the right median base and that the x-ray therapy had produced no change in the appearance of the chest (Fig. 3, C).

CASE 6: A. B. (474170). A 51-year-old woman some 50 pounds overweight entered University Hospital in July 1945, for treatment of deformities resulting from rheumatoid arthritis. She had no chest symptoms and on physical examination the cardiorespiratory system was thought to be normal. The admission photofluorogram of the chest, however, showed a large tumor at the median base of the right lung. Additional films confirmed this finding and localized the mass to the anterior cardiophrenic angle (Fig. 3, D). Fluoroscopy showed transmitted pulsation and slight respiratory movement of the mass which, despite its large size, appeared particularly radiolucent in frontal projections. Examinations of the esophagus and entire gastro-intestinal tract were negative.

Observation rather than operation was advised in this instance, and check-up roentgenograms six months later (January 1946) showed no change. The patient has lost considerable weight during the past five months and, interestingly enough, the mass at the right cardiophrenic angle apparently has decreased in size. If this observation is accurate, it may be of some diagnostic value.

Comment: In retrospect, we are of the opinion that the first three patients in this group (Cases 3, 4, and 5) have large epipericardial fat pads rather than the serious abnormalities originally diagnosed. In the case of the fourth patient (Case 6), an original diagnosis of fat pad was made chiefly as the result of previous experience, despite the very large size of the mass

Before discussing additional points in differential diagnosis, another group of patients is worthy of consideration.

CASE 7: M. H. (562958). A 23-year-old woman had a right median base shadow discovered when chest roentgenograms were obtained because of a slight cough. In frontal projection a pear-shaped mass closely resembling the fat pad shadow observed in Case 1 was seen, but a lateral view showed it to be located far posteriorly in the chest (Fig. 4, A and B). Thoracotomy and subsequent pathological examination showed a *tracheobronchiogenic cyst.*

CASE 8: W. H. (488216). A child of 7 years had an abnormal finding at the right cardiophrenic

angle (Fig. 5, A) closely resembling the fat pad shadow in Case 1. Lateral projection once again was extremely helpful, localizing the abnormality to the posterior portion of the right lower lobe (Fig. 5, B). Review of the record in this case indicated that the child had had known apical tuberculosis for three years. Roentgenograms exposed two months previously had revealed parenchymal infiltration in the right lower lobe. Interval films showed rapid coalescence of this infiltration into a homogeneous, smoothly circumscribed mass, thought to be a *subpleural tuberculoma*.

CASE 9: F. H. (250398). The patient was a graduate nurse, age 23, whose confusing right median base shadow appeared in 1935 at a time when her tuberculin reaction changed from negative to positive. Roentgenograms the previous year were negative. By 1940, the shadow at the right cardiophrenic angle had been replaced by a small, round, densely calcified scar, clearly identifying the lesion as *primary tuberculosis*.

CASE 10: A. A. (509111). Discovery of a large pear-shaped shadow of increased density at the right cardiophrenic angle on the admission photofluorogram of a 70-year-old man prompted further investigation. Examination of the esophagus with the aid of barium showed a severe degree of *cardiospasm*. The dilated lower esophagus projected into the right side of the chest (Fig. 6, A and B), producing the shadow which so closely resembles epipericardial fat deposition.

CASE 11: B. L. (272382). An obese woman, 51 years of age, was admitted to University Hospital for treatment of carcinoma of the cervix. Her routine chest photofluorogram showed a triangular shadow adjacent to the right heart border, and although it was thought to be epipericardial fat, additional films were requested. A peculiar area of decreased density subsequently seen through the heart shadow proved to be a bubble of air within the stomach, which was partially herniated through the esophageal hiatus. The suspected right epipericardial fat deposit proved to be the medial aspect of the *herniated gastric cardia*.

CASE 12: F. K. (528187). The cause of vague gastro-intestinal complaints in a 57-year-old man was not suitably explained by clinical examination. His routine chest photofluorogram, however, had shown an apparently abnormal shadow at the median base of the right lung, prompting further examination. Regular chest films showed a continuation of this shadow behind the heart, suggesting the presence of diaphragmatic hernia, and barium was fed to prove it. The stomach was found to be in the normal position, and the mass proved to be a large pulsating *aneurysm* of the descending aorta. Typical erosion of lower thoracic and upper lumbar vertebrae in addition to a four-plus Kahn reaction clinched the diagnosis.

CASE 13: W. B. (500319). A rounded shadow of increased density at the right cardiophrenic angle of a 13-year-old boy was overlooked in January 1943. The configuration of this shadow, as seen in frontal projection, closely resembled an epipericardial fat pad, and, furthermore, a lateral view localized it to the anterior portion of the chest. Three months later, roentgenograms of the chest showed pronounced increase in size of the shadow in question, thus furnishing conclusive evidence of its serious nature. As a diagnosis of lymphoblastoma had been made previously on the basis of cervical lymph node biopsy, it was assumed that the rapidly growing chest tumor represented an intrathoracic manifestation of this disease. This assumption was adequately confirmed by prompt disappearance of the mass following a moderate amount of x-ray therapy.

CASE 14: E. B. (488531). A 48-year-old woman entered University Hospital with complaints of cough and sputum for the previous four years. The admission photofluorogram of the chest showed a small, triangular, fat-pad-like shadow at the right cardiophrenic angle. With the assistance of additional roentgenograms, bronchography, and bronchoscopy, this finding, originally thought to be of questionable significance, resolved itself into atelectasis and bronchiectasis of the median basilar segment of the right lower lobe (Fig. 7, A and B).

Comment: Single postero-anterior roentgenograms of the chest in each of these last eight patients (Cases 7 to 14) presented a shadow of increased density at the right cardiophrenic angle very similar to the epipericardial fat shadows previously described. In every instance, however, further examination resulted in identification of lesions which were of real concern to the patient. Usually a lateral roentgenogram of the chest was all that was necessary to establish the presence of significant intrathoracic disease.

We have observed a number of other important lesions resembling epipericardial fat deposits, which might well be added to those already described. Metastatic neoplasm, eventration and other anomalies of the diaphragm, diaphragmatic tumor, paraspinal effusion following splanchnicectomy, rotoscoliosis, and even a large hypertrophic osteophyte constitute a portion of the list. Upward retraction of the medial aspect of the right hemidiaphragm incident to fibrotic tuberculous scarring in the apex of the right lung also should be mentioned.

Mazer (7) recently has reported an operatively proved case of true pericardial diverticulum, the roentgenologic appearance of which was virtually indistinguishable from epipericardial fat. He suggests cardiac aneurysm or neoplasm and encapsulated pericardial effusion as additional entities to be considered in the differential diagnosis.

It is obvious, then, that the problem of differential diagnosis of one of these right median base shadows resolves itself into the following question: "Is this an unimportant, incidental observation to be dismissed lightly or is it a finding of real importance to the patient?"

The major responsibility of supplying the answer to this seemingly fair question appears to lie squarely upon the shoulders of the roentgenologist. Admittedly, unequivocal evidence of an epipericardial fat deposit, short of thoracotomy and direct examination of the offending mass, is difficult if not impossible to obtain. As exploratory operations are always undesirable if less drastic means of diagnosis can be satisfactorily employed, it behooves us to weigh very carefully the various procedures which might be helpful in the final evaluation of these patients.

First of all, we believe it inadvisable to attempt a roentgenologic diagnosis of a suspected epipericardial fat deposit on the basis of its appearance in a single posteroanterior projection of the chest, especially if that single projection is on miniature film. Frontal and lateral roentgenograms of regulation size should always be obtained and, in certain instances, fluoroscopy and oblique projections will be helpful.

The size, shape, and density of the shadow in question should be carefully analyzed. Epipericardial fat pads vary considerably in size and, although exceptions have been encountered, reach their largest proportions in obese individuals. In any given patient, the size of the fat pad may vary in direct proportion to over-all changes in body weight.

As has been shown, the shape of a right-sided fat pad is neither consistent nor entirely characteristic. In frontal projection it most frequently assumes a triangular configuration, the outer margin of which is somewhat convex. In lateral view, the fat pad invariably is located at the anterior costophrenic sulcus, and the extremities of its smoothly marginated, bow-shaped posterior border appear to fuse gently with the anterior chest wall. Significant intrathoracic lesions in the lower portions of the lungs seldom have this appearance and are more apt to be posterior in position.

Fat is considerably less dense than other soft tissues, but unfortunately when it is projected against a background of air-containing lung, this ordinarily useful differential in density is lost to a considerable degree. At times, in frontal projection, the pericardial pleura can be seen as a fine linear shadow of increased density around the lateral margin of the more radiolucent fat deposit, yet this is by no means a constant finding. Comparison of fat pad density with that of the heart is not very satisfactory because of the marked difference in thickness of the two structures.

Complete examination of the gastrointestinal tract, including barium enema, should be done at times to rule out possible herniation of the stomach or colon through the anterior portion of the diaphragm. Omental hernia in the same location is supposedly associated with localized upward displacement of the mid-transverse colon.

Bronchography and bronchoscopy may be of assistance if there is reason to suspect a bronchiogenic neoplasm or middle lobe atelectasis from some other cause.

In the final analysis, perhaps the most useful diagnostic agent in dealing with these confusing right median base shadows is the passage of time. Periodic check-up examinations are advisable even when the evidence at hand is overwhelmingly against the presence of dangerous pulmonary or mediastinal abnormality.

SUMMARY

For a long time, roentgenologically visible accumulations of epipericardial fat

have been classically associated with the left side of the heart. Less well recognized but even more bothersome is the occasional occurrence of similar fat pads along the right lateral margin of the cardiac shadow. In this position, the fat deposits, which are located between the pericardium and the pericardial pleura, may assume large proportions and simulate significant intrathoracic lesions. The entire matter is one which presents trying diagnostic difficulties that have been most troublesome to us in the course of admission chest surveying. Specifically cited cases indicate that one cannot afford to identify all triangular or ovoid shadows at the right cardiophrenic angle as epipericardial fat deposits. Consequently, many persons having innocent lumps of adipose tissue attached to the right side of the pericardium must of necessity be subjected to extensive examination.

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Cardio-Esophageal Relaxation as a Cause of Vomiting in Infants[1]

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PERSISTENT OR recurrent vomiting in the newborn or young infant occurs as a frequent problem in pediatric care. This disturbance may be produced by a variety of causes that need not be enumerated here. A large percentage of cases are due to parenteral factors and are usually not subjected to radiologic examination. There remain a considerable number of patients in whom, because of the repeated and significant nature of the vomiting, roentgenologic examination is warranted. Among this group we have observed, in the past three years, 12 patients who exhibited persistent vomiting evidently due to relaxation or dysfunction of the hiatus portion of the esophagus with failure of the normal "sphincter" action of the cardia. In only one instance have we seen this condition beyond the neonatal period. This was in a boy of four who had vomited many feedings and many meals since birth. Berk (2) has reported the case of an adult with a similar clinical and radiographic picture. Because in many respects the condition appears to be the opposite of achalasia of the esophagus, we frequently have referred to the persistent relaxation as "chalasia."

The etiology of this condition is not certain, and one can only speculate as to its probable cause. The normal hiatus esophagus does not gape, but is closed by the pinchcock action of the diaphragm (4). One could postulate that this type of persistent relaxation might be the result of failure of the pinchcock mechanism to function adequately, due to failure of proper development or to imbalance of neuromuscular control. The sphincter-like muscular tonicity at the level of the diaphragm must be relaxed to allow the passage of food into the stomach, but if an appreciably relaxed state is allowed to remain, there will be a reflux of gastric contents into the esophagus and regurgitation will result. The cardiac sphincter is kept normally closed. The nervous control of the cardia is such that vagal stimulation or sympathetic inhibition results in relaxation of the cardia, while vagal inhibition or sympathetic stimulation produces contraction. The tone of the cardia may also be inhibited by mild stimulation of the gastric mucosa or by sensory impulses arising in the mouth and pharynx. If, as has been postulated, achalasia or cardiospasm may be produced by sympathetic-parasympathetic imbalance, there is no reason to doubt that the same forces operating in the opposite direction may result in chalasia or relaxation of the cardia. Indeed, the surprising thing is that it has not been observed more often. As there have been no deaths in this series, we have not had the opportunity to observe whether there is any visible failure or lack of development to account for this difficulty.

The clinical story is usually well defined. The disease is seen with equal frequency among both male and female infants. The patient almost invariably starts vomiting within a week after birth, usually during the first few days of life. The vomiting becomes progressively worse and soon occurs with each feeding. The infant appears otherwise well and hungry. Regurgitation or vomiting is rarely forceful, almost never projectile, and the vomitus does not contain bile although it may contain visible gastric secretions. Vomiting may take place during a feeding, especially when air is expelled, but is most apt to occur when the child is put back in his

[1] From the Departments of Radiology and Pediatrics, Harvard Medical School, and from the Departments of Roentgenology and Pediatrics of the Infants' and Children's Hospitals, Boston, Mass. Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–6, 1946.

crib in the supine or decubitus position. None of our patients has had significant associated anomalies, although in one infant who had a typical history lasting for five months hematemesis developed and a bleeding hemangioma was subsequently found a small distance above the cardia. All the cases were studied intensively as to other possible causes of vomiting, and no abnormalities were discovered. Untreated, the infant gains slowly even over a period of months, and the more severe cases in the newborn show no weight gain or even a slight loss. Physical examination reveals nothing unusual other than varying degrees of malnutrition.

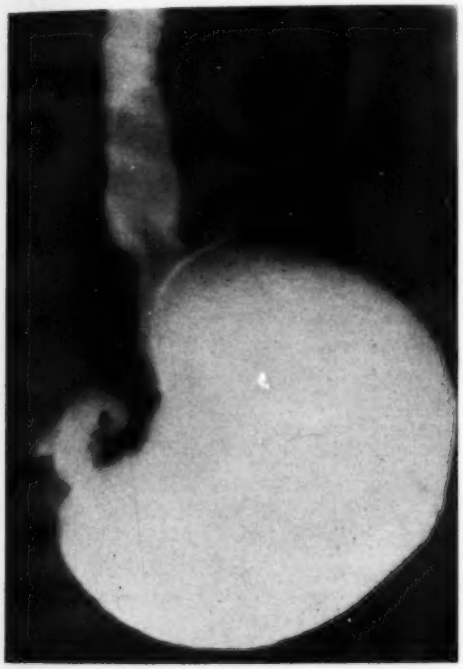

Fig. 1. J. T., male infant. Moderate relaxation of the cardia. Stomach, pyloric canal, and duodenum are normal.

The diagnosis of cardio-esophageal relaxation depends almost entirely on an adequate fluoroscopic examination of the swallowing function, esophagus, and stomach. A sufficient quantity of barium for adequate visualization is mixed with the infant's formula, or with 5 per cent glucose, and the mixture is administered from an ordinary nursing bottle with nipple. The barium-filled esophagus usually appears larger than usual and gives the impression of being thin-walled and relatively flaccid. Esophageal peristalsis is nearly always diminished in strength and frequency. Some relative narrowing of the hiatus esophagus is observed, but there is persistent failure of the "pinchcock" or "sphincter" action to come into play, so that the esophagus appears as a rather flaccid tube leading to the cardiac end of the stomach. During the inspiratory phase of respiration the esophagus dilates and frequently will fill with barium from the stomach, as there is no obstructing mechanism to prevent regurgitation of the gastric contents. With expiration, the filled esophagus is compressed; some of the barium passes again into the stomach and some is regurgitated into the mouth. Occasionally this regurgitation induces a gag reflex followed by true vomiting. Unless this occurs, the changes usually

Fig. 2. R. D., female infant. Extreme relaxation of the hiatus esophagus. Retrograde filling during inspiration.

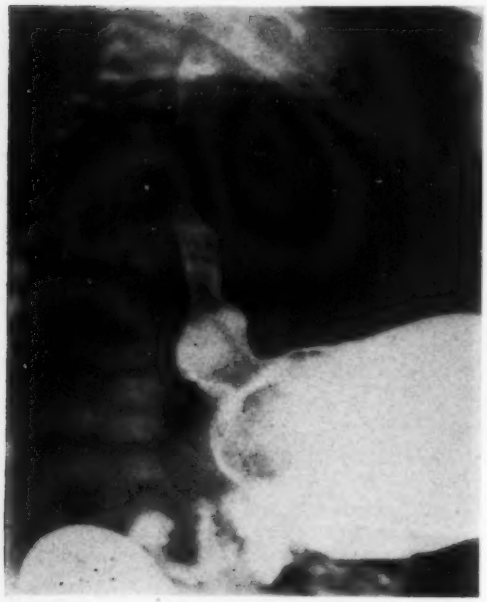

Fig. 3. L. W., female infant. Moderate relaxation of cardia. Filling of esophagus produced by slight pressure upon the abdomen.

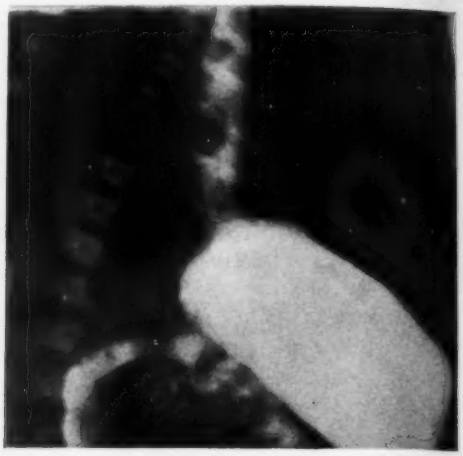

Fig. 4. Baby S., male infant. Normal emptying of stomach but with moderate cardio-esophageal relaxation.

associated with true vomiting, such as contraction of the diaphragm, reverse peristalsis, and strong contraction of the stomach, do not occur. When the patient is in the supine position, even slight pressure upon the abdomen will produce retrograde filling of the esophagus with air or barium from the stomach. An increase in intra-abdominal pressure from crying or struggling will produce a similar result. If the patient is observed in the erect position, no regurgitation takes place, although it is usually evident that the hiatus esophagus is open, as frequently one can observe air passing into the esophagus from the stomach. It is probable that the hiatus portion of the esophagus does not remain patent at all times, but the persistent relaxation is easily recognized.

Treatment of this condition has been empiric. The patients are fed in the sitting or erect position and maintained in this position for thirty minutes after the feeding has been accomplished. Mild variations of this syndrome may need no more therapy than this, and certainly most pediatricians have encountered infants who regurgitate easily but need no more in the way of corrective measures than this simple technic. In a certain number of cases so corrected some variant of chalasia may be the basic difficulty. Again, we have all seen infants who had appreciable regurgitation until they assumed the erect position in the normal sequence of their growth and development.

In the presence of well defined, persistent relaxation we have, in addition, kept the infant propped up and maintained in a semi-sitting position in its crib throughout the day and night. This has been accomplished by the use of pillows and a semi-harness for support. Formula feedings were thickened with one ounce of cereal to 15 ounces of formula to achieve a heavier mixture, which would be less likely to reflux up through the relaxed cardia. No drugs were employed.

On such a regime all of the infants stopped vomiting almost immediately and showed good weight gain and normal development. This regime was carried on easily for several months at home. We have had the opportunity to examine a number of the patients several months

after the original diagnosis was made, and at that time they have shown no abnormalities on physical or fluoroscopic examination and were able to carry on in a perfectly normal fashion.

SUMMARY AND CONCLUSIONS

(1) Persistent relaxation of the hiatus esophagus is an important but rather infrequent cause of vomiting in the newborn or young infant.

(2) Twelve patients with this condition have been seen during the past three years.

(3) The clinical picture of persistent regurgitation that can be alleviated when the patient is placed in the erect position suggests the diagnosis.

(4) The diagnosis can be made with certainty only by fluoroscopic examination. Retrograde filling of the esophagus during inspiration or with increase in intra-abdominal pressure with persistent relaxation of the hiatus esophagus is diagnostic.

(5) The condition appears to be, in the majority of instances, a temporary aberration of the neuromuscular function of the hiatus portion of the esophagus and diaphragm.

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Fig. 5. S. R., male infant. Severe cardio-esophageal relaxation. Entire esophagus shows dilatation and retrograde filling with inspiratory effort.

DISCUSSION

Lewis G. Allen, M.D. (Kansas City, Kansas): Regurgitation in infants to us fathers and some of us grandfathers is a common experience. The burping pad of young mothers indicates the frequency of the occurrence of esophageal regurgitation and it takes one with the experience of Dr. Neuhauser to pick twelve cases out of two thousand gastro-intestinal examinations in infants, in order to point out to us the existence of a mechanism that might explain our observations in cases of special severity.

It seems to me that Dr. Neuhauser has stated the question, has given us the explanation, and has closed the book. There is certainly no point of controversy. We are indebted to him for having brought this matter to our attention and personally at least I believe that I will be a little more tolerant of the pediatrician who is anxious to know if there may be a mechanical explanation or an error in the neuromuscular mechanism as has been suggested by Dr. Neuhauser.

Lymphoblastoma

An Evaluation of the Differences in Sensitivity to X-Ray Irradiation of Different Types, and Its Application to a Quantitative Therapeutic Test[1]

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IN THIS PAPER an attempt will be made to evaluate the differences in radiosensitivity of the various types of lymphoblastoma, and a plan will be presented for distinguishing between the types by means of a quantitative therapeutic test with x-ray irradiation, when a mass presents itself in the mediastinum or abdomen and no lymph node is available for biopsy.

TISSUE SENSITIVITY IN GENERAL

It is a well established fact that different tissues respond with different degrees of sensitivity to irradiation. Bergonié and Tribondeau established the axiom that cells are most sensitive in their embryonic state. Normal cells that are less differentiated respond more quickly than those that are adult in type. This apparently depends on the presumption that less differentiated cells have a greater power of reproduction and the fact that cells are most sensitive to irradiation during their mitotic stage.

The response of neoplastic tissues to irradiation is governed by the same factors. Since neoplastic tissues are rapidly growing, they show a high degree of mitotic activity and hence are more sensitive to irradiation. Other influences, however, come into play. As Kaplan (6) has pointed out, the response of neoplastic tissue to irradiation depends, also, on (*a*) the condition of the patient, (*b*) the position and situation of the lesion, (*c*) the extent of invasion, and (*d*) the bed of the tumor, its nutritional supply and vascular system, all of which are essential to tumor growth.

Most observers agree that the lymphocyte and its predecessor, the lymphoblast, are the most sensitive cells in the body. It should be recalled, moreover, that the adult lymphocyte is the end product of a series of more immature cells comprising the lymphocytic series. It would be logical to assume that the more immature cells of the group, the lymphoblasts and prolymphocytes, would be most sensitive.

Bearing in mind these general remarks, the individual radiosensitivity of lymphoblastomas will be classified and discussed.

TYPES OF LYMPHOBLASTOMA AND THEIR RELATIVE RADIOSENSITIVITY

The lymphoblastomas may be classified as follows:

1. Giant follicular lymphadenopathy.
2. Lymphatic leukemia.
3. Lymphosarcoma.
4. Polymorphous-cell sarcoma.
5. Hodgkin's disease.

1. *Giant Follicular Lymphadenopathy:* While giant follicular lymphadenopathy is not essentially a malignant lymphoblastoma, it has been included in this group because, according to an estimate by Symmers (11), as many as 20 per cent of the cases may undergo transformation into polymorphous-cell sarcoma, Hodgkin's disease, or leukemia. Rubenfeld (10) has demonstrated the extreme radiosensitivity of this condition, effecting not only control but probably cure with individual x-ray doses of 100 to 150 r to the involved lymph nodes or spleen, and total doses ranging from 300 to 1,200 r measured in air. The factors he used were 200 kv., 10 to 20 ma., 0.5 mm. Cu + 1.0 mm. Al, at distances

[1] From the Radiation Therapy Department (Dr. Ira I. Kaplan, Director), Bellevue Hospital, New York. Accepted for publication in August 1946.

of 40 to 50 cm. Histologically, the lymph nodes in this condition are characterized by a numerical and dimensional hyperplasia of the lymph follicles, which are delimited by a zone of deeply staining small lymphocytes. The germinal areas are made up of large hypochromic embryonal cells and relatively deeply staining small embryonal cells of the large lymphocytic type. Although these cells are not malignant, they are embryonic in type. This fact may explain the extreme degree of sensitivity. The absence of malignancy explains the permanence of cure.

2. *Lymphatic Leukemia:* Lymphatic leukemia is characterized by the appearance in the blood stream of immature lymphocytes (prolymphocytes). In the acute forms, even lymphoblasts are present in the blood. Widmann (15) and Haden (5) have pointed out that leukemia is not necessarily accompanied by an abnormal number of white blood cells. One third of Haden's cases did not have an elevated count.

There is usually a generalized enlargement of the lymph nodes, although certain groups may be affected to a greater extent than others. Histologically the lymph nodes show complete replacement of the normal structure by immature lymphocytes of all types. Occasionally these cells are seen to invade the capsule and even neighboring structures.

Lymphatic leukemia is extremely sensitive to small doses of radiation, resembling giant follicular lymphadenopathy in this respect. The patient, however, usually succumbs to the disease. Irradiation causes the associated symptoms to subside, but the disease eventually recurs, thus demonstrating its malignancy. Irradiation is, therefore, only palliative, not curative.

The differential diagnosis of lymphatic leukemia from the other lymphoblastomas lies in the demonstration of abnormal cells in the blood stream. Even in so-called aleukemic leukemia, careful and repeated examination of blood smears will eventually establish the diagnosis.

At times, in a certain significant number of cases, as emphasized by Symmers (12), this disease may be represented by a preponderance of enlargement of the abdominal and/or thoracic lymph nodes, or spleen. Under these conditions, with an aleukemic blood picture, differentiation from other lymphoblastomas may present a problem.

3. *Lymphosarcoma:* Lymphosarcoma is characterized by the malignant proliferation of one of the lymphocytic series of cells. Kundrat, according to Symmers, predicated a tendency on the part of the process to confine itself within more or less sharply defined limits, but noted its proclivity to expand locally and often ruthlessly. Of Symmers' 17 cases of lymphosarcoma encountered at necropsy in Bellevue Hospital, 9 were locally limited, while 8 showed expansion and invasion of neighboring tissues. In 70 of a series of 100 cases reported by Kundrat, Ghon and Roman, MacCallum, and Symmers (12), lymphosarcoma occurred preponderantly or "primarily" in the deeper structures, including, in the order of their frequency, the gastro-intestinal tract, thymus, abdominal nodes, spleen, and thoracic nodes. In the remaining 30 cases, the following lymph nodes were predominantly involved: cervical in 14; superficial structures of the gastro-intestinal tract, including pharynx, tonsils and mouth, in 12; inguinal and axillary nodes and prostate, 4.

Three types of lymphosarcoma are recognized, according to the predominant cell—the small-cell lymphosarcoma, large-cell lymphosarcoma, and reticulum-cell lymphosarcoma. Perhaps the last named type, arising, as the term implies, from the reticulum cells in the germinal centers and parenchyma of the lymph node, is not strictly a lymphosarcoma, in view of the fact that the relationship of the reticulum cell, if any, to the lymphocyte is not definitely known (12).

The radiosensitivity of the lymphosarcoma is well recognized. Theoretically, it is possible to determine a difference in sensitivity between the small-cell and the large-cell types; the latter, being the

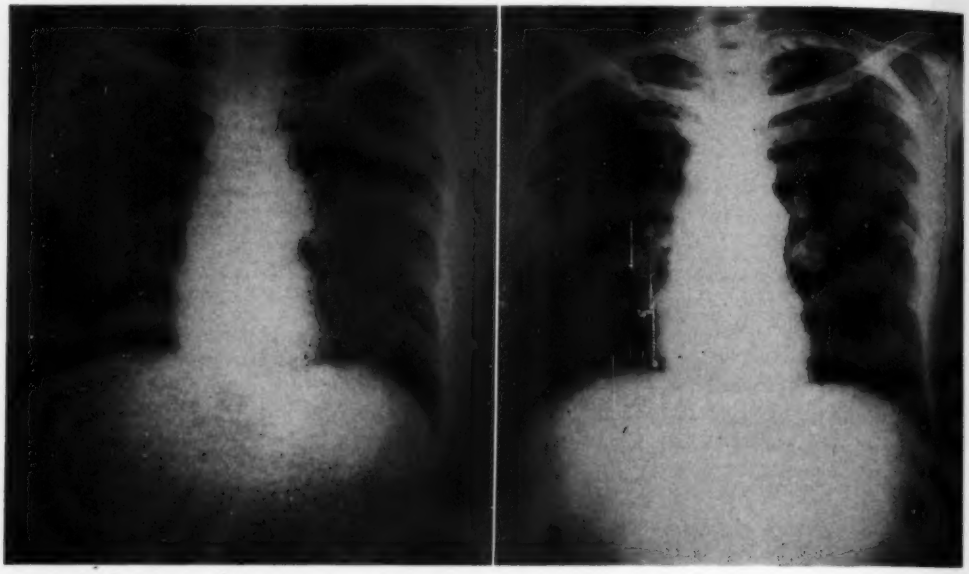

Fig. 1. A. Prominent mediastinal tumor on left side. On the same day that this film was taken, 300 r, measured in air, were delivered through a 10 × 15-cm. port. The dose was repeated the next day. Factors were: 200 kv., 20 ma., 50 cm. T.S.D., 0.5 mm. Cu + 1.0 mm. Al filter, H.V.L. 0.9 mm. Cu.

B. Film taken on the fifth day following the beginning of treatment, showing almost 50 per cent reduction in the size of the mass. This response is typical of lymphosarcoma or giant follicular lymphadenopathy. Leukemia with a mediastinal mass may also respond in this way. In this case therapy was continued to 1,800 r in daily doses of 300 r, with practically complete disappearance of the mass.

The patient was a 44-year-old white male who entered Bellevue Hospital in February 1946, complaining of intermittent fever, malaise, and weakness of two months' duration. He was found to have a 4-plus Wassermann reaction. In the hospital he had several bouts of fever of 103–104° F, accompanied by a macular rash over the trunk, which disappeared during the remissions, which lasted seven to ten days. He had inguinal and axillary adenopathy. The liver and the spleen were not felt at first, but in June and July both were found to be enlarged. Roentgenograms of the chest were at first interpreted as showing aneurysm of the ascending aorta. Courses of penicillin and sulfadiazine had no effect on the clinical course. Two lymph node biopsies showed chronic lymphadenitis. Blood counts and sternal puncture were normal, except for an increasing anemia. The white blood count became depressed under the influence of roentgen therapy to the lymph nodes and to the retroperitoneal area. The fever receded following therapy to the retroperitoneal area. The axillary and inguinal lymph nodes disappeared following irradiation. Agglutination tests of all types were negative. At the present time the patient is running a low-grade temperature, is symptom-free except for weakness, shows a recession of lymph nodes and the mediastinal mass, and has a slightly enlarged liver and spleen. It seems probable that the diagnosis is lymphosarcoma, which has been brought under temporary control by irradiation.

younger or more embryonic of the two, should be more radiosensitive. Clinical control and differentiation, however, combined with adequate pathological studies have not been easily possible. As to the reticulum-cell variety, the fact that its cell of origin is more of the connective-tissue type may explain the observation that in any given series of cases of lymphosarcoma there are usually a few that prove to be more radioresistant than the others. Perhaps this cell variety belongs more properly with the polymorphous-cell sarcomas, to be described later.

Because of its radiosensitivity, lymphosarcoma may be held in check for varying periods of time with comparatively small doses of radiation. With one or two doses totaling 200 to 600 r measured in air, delivered at 200 kv., 20 ma., with a filter of 0.5 mm. Cu and 1.0 mm. Al, a mediastinal or abdominal mass large enough to give severe pressure symptoms, will diminish in size as much or more than 50 per cent in a period of three or four days, thereby bringing about striking relief of symptoms. In spite of this notable response, however, sooner or later, whether because of local invasiveness or because of metastases or multiple neoplastic foci,

lymphosarcoma often breaks its bounds and is no longer controllable by irradiation.

4. *Polymorphous-Cell Sarcoma:* Polymorphous-cell sarcoma was first described by Symmers (13) in 1938, in presenting clinical and histologic studies showing the capacity of giant follicular lymphadenopathy to undergo direct transformation into this disease, having multiple foci of origin in hyperplastic lymph follicles. Apparently the disease is derived from a proliferation of cells which eventually rupture from a large follicle. Morphologically the large hypochromatic or shadow cells are traceable through smaller transitional cells into still smaller hyperchromatic cells which resemble large lymphocytes. Symmers chose to employ the term polymorphous-cell sarcoma rather than lymphosarcoma until more conclusive evidence should be found that the unit of growth is the lymphocyte. The lymph nodes in this disease are slow growing in contradistinction to those in either Hodgkin's disease or lymphosarcoma. Rubenfeld (10) has demonstrated that this condition is relatively radioresistant. It differs in this respect from the extremely radiosensitive lymphosarcoma. In Rubenfeld's cases, doses of 1,300 to 2,500 r measured in air were necessary to cause recession in size or disappearance of the involved lymph nodes.

It may be postulated that the relative radioresistance of polymorphous-cell sarcoma may be attributable to its cell composition. Since the exact derivation of the offending cell is not known, and since indeed the relationship of the cell to the true lymphocyte is in doubt, it may be reasonable to assume that its radioresistance is due to a possible origin from the supportive tissues of the lymph node rather than the true lymphocytic germinal center. In this respect, it resembles the so-called reticulum-cell lymphosarcoma.

5. *Hodgkin's Disease:* This well known, but not well understood, disease is characterized by generalized involvement of the lymphoid and reticulo-endothelial system, including the spleen, by a characteristic pathological process. Clinically the disease is usually pictured as beginning in the cervical lymph nodes, with gradual extension to the other lymphoid structures of the body, accompanied by increasing weakness, anemia, and occasionally intermittent fever, often of the Pel-Ebstein type. Desjardins (2, 3) has pointed out the clinical importance of the retroperitoneal lymph nodes and the great variety of symptoms which their involvement in Hodgkin's disease can cause. Symmers (12) has shown the high percentage (63 per cent) of cases in which the abdominal lymph nodes or the combined abdominal and thoracic lymph nodes are predominantly involved.

According to Newell (8), Hodgkin's disease is never purely local. He bases his statement on the fact that he has never succeeded in curing a case, however early the treatment was begun, and has never seen a case cured by surgical extirpation of the group of enlarged nodes.

Microscopically, Hodgkin's disease is characterized by the replacement of the normal lymph node structure by what is apparently a hyperplasia of the reticulo-endothelium (1). One of the most noteworthy features is the pleomorphic cytology, in which respect the condition differs from lymphosarcoma. Mononuclear and multinuclear giant cells (Dorothy Reed or Sternberg) are characteristic. Lymphocytes, plasma cells, neutrophilic and eosinophilic polymorphonuclears may all be present, the eosinophils being particularly characteristic, though not invariably present. There is a notable increase in reticulum, which appears as coarse straight fibrils. Fibrosis may be marked in late cases and, according to Graef (4), is characteristically present even in early stages. Necrosis is sometimes seen, particularly in the spleen.

Most observers have found that, of all the lymphoblastomas, Hodgkin's disease is probably the most refractory to radiation therapy. The response of involved nodes or masses depends, however, a great deal on their position and upon the stage of the

disease. In general, the superficial lymph nodes will respond to relatively mild doses of x-ray radiation, up to 1,000 r. Deep-seated masses, on the other hand, as shown by Wolpaw *et al.* (14) in a discussion of intrathoracic Hodgkin's disease, often require as much as 2,000 to 3,000 r measured in air to cause regression.

THERAPEUTIC TEST WITH IRRADIATION AND ITS PRACTICAL APPLICATION

The various types of lymphoblastomas discussed above, as has been pointed out, show, in general, definite though not marked differences in radiosensitivity. In most cases, the problem of diagnosis is easily solved by the careful histologic examination of an excised lymph node. In the case of lymphatic leukemia, a blood smear will usually suggest the diagnosis.

As Symmers and Desjardins have demonstrated, however, the various types of lymphoblastoma not infrequently invade a deep-lying group of nodes or mass of lymphatic tissue, either intrathoracic or abdominal, with little or no involvement of superficial lymph nodes. In such an event, a lymph node may not be available for biopsy. Hence a presumptive diagnosis will have to be arrived at in another way.

It is conceivable that even lymphatic leukemia, in an aleukemic form, may involve predominantly the deeper lymphoid structures. The problem of diagnosis in such a situation may be a perplexing one. Wyckoff (8), however, states that he has never found a case of aleukemic leukemia in which intensive search of the slides did not give information, or at least a strong presumption, of the ultimate development into frank leukemia. Hence it is believed that an aleukemic leukemia presenting predominant enlargement of internal lymphoid structures can be eliminated from our diagnostic problem. It is to be recommended, however, that every case presenting such a picture should have a careful blood study to rule out leukemia. Moreover, sternal puncture and marrow smear examination will often aid in making the diagnosis.

Although giant follicular lymphadenopathy has usually been described as a clinical entity characterized by generalized enlargements of the superficial lymph nodes with or without splenomegaly, Symmers (12) has reported one case recorded by Terplan and one by himself, in three known necropsies, in which the retroperitoneal nodes were enlarged to an enormous extent while there was little or no enlargement of the superficial nodes. In the third case, also, the retroperitoneal nodes were enormously enlarged, but there was some enlargement of the nodes in the neck and groin as well. Hence giant follicular lymphadenopathy must be considered along with lymphosarcoma, polymorphous-cell sarcoma, and Hodgkin's disease when a patient presents himself with clinical or roentgenologic evidence of a mass in the mediastinum or abdomen.

It is not within the scope of this paper to discuss the differential diagnosis between the lymphoblastomas and other conditions which may present themselves in the form of mediastinal or abdominal masses. Let it suffice to mention those conditions which must be differentiated. In the mediastinum a group of malignant neoplasms may occur which are sensitive only to large doses of radiation. Of those, reticulum-cell sarcoma, endothelioma, and embryonal spindle-cell sarcoma may fall into the same classification of radiosensitivity as the more resistant Hodgkin's disease. Other malignant tumors are fibrosarcoma, melanosarcoma, carcinoma of the thyroid and thymus, teratoma, neurogenic sarcoma, and certain esophageal and bronchiogenic carcinomas. These are practically insensitive to radiation, although some degree of response may occur after large doses (7, 9). In the latter event, the mass almost inevitably re-expands. Benign tumors include dermoid cysts, fibroma, lipoma, neuroganglioma, chondroma, and sarcoid. Masses simulating tumors are mediastinal abscess, encysted pleural fluid, echinococcus cyst, and aneurysm. It may be mentioned that the thymus may be involved primarily or pre-

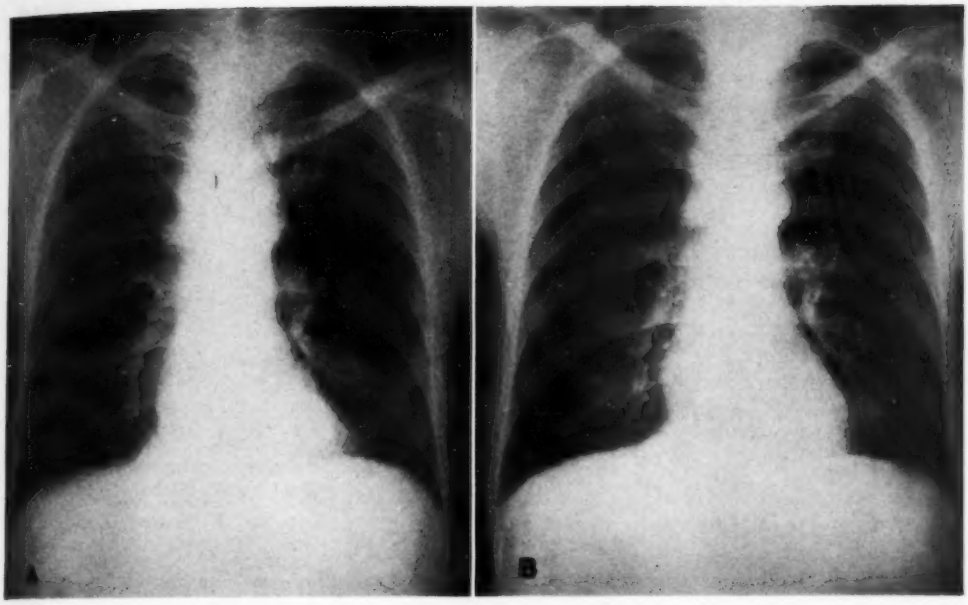

Fig. 2. A. Small mass projecting from the right side of the mediastinum.

B. Appearance of mass following 200 r to each of two posterior ports, and 400 r to each of two anterior ports, each 10 × 15 cm. Factors were: 200 kv., 20 ma., 50 cm. T.S.D., 1.0 mm. Cu + 1.0 mm. Al filter, H.V.L. 1.4 mm. Cu. The mass has decreased in size about 25 per cent.

The patient was a 48-year-old white male who was first seen in our clinic in January 1941, with an enlarged lymph node, 4 × 5 cm., at the angle of the right jaw, a preauricular node 2 × 2 cm., several smaller anterior cervical nodes, and a large node, 4 × 4 cm., in the right axilla. The pathological report on nodes removed from the left axilla and left inguinal region showed a giant follicular lymphadenopathy. The preauricular and submandibular nodes responded excellently to a total of 600 r, in divided weekly doses of 150 r. The axillary nodes practically disappeared following administration of a total of 450 r, in divided weekly doses of 150 r.

In April 1941, the patient returned with swelling of the left lower extremity, several small nodes in both inguinal regions, and a hard fixed node in the region of the previous biopsy incision in the left inguinal region. It was thought that these findings represented a sarcomatous change, and 2,600 r were given in daily doses of 200 r to each inguinal region. The nodes subsided.

In September 1941, there was recurrence of bilateral inguinal nodes, with swelling of the left leg; 1,500 r were then given to anterior and posterior ports directed at the left inguinal region, and 1,500 r to the right inguinal area. The nodes again subsided and the general condition of the patient remained fairly good. He returned in July 1944, with enlarged lymph nodes in the left suboccipital area and preauricular regions, right supraclavicular fossa, both axillae, and right inguinal area. Liver and spleen were not palpable. A chest film showed no hilar or mediastinal adenopathy. From July to October 1944, the left preauricular area and both axillae received 2000 r each, and the right supraclavicular and both inguinal areas received 800 r each, followed by recession of the lymph nodes.

The patient was seen in 1945 and was essentially well. He returned in June 1946, complaining of a sore mouth and enlarged nodes in the left submandibular region. There were smaller nodes on both sides of the neck. No lymph nodes were palpated elsewhere. The liver and spleen were not enlarged. The chest film showed a node about 5 cm. in diameter extending out to the right from the mediastinum. The submandibular nodes diminished in size 75 per cent as a result of two doses of 200 r each. The mediastinal mass responded as indicated in the films reproduced herewith. In spite of this response, the mouth condition, an aphthous stomatitis, became worse. The patient was admitted to the hospital, and placed on penicillin therapy and vitamins. Two days after admission a generalized macular rash developed, which was termed a toxic erythema multiforme by the dermatologist. The general condition became rapidly worse and the patient died one month after his return to us. Autopsy was not obtained.

The course of this case, with the recurrence of lymphadenopathy and the increasing dosage of irradiation needed to control it, suggested polymorphous-cell sarcomatous degeneration of a previously diagnosed giant follicular lymphadenopathy. The response of the mediastinal tumor to 1200 r divided among four ports is believed to be rather typical of a polymorphous-cell sarcoma.

dominantly by any one of the lymphoblastomas. In the abdomen conditions to be differentiated from lymphoblastoma are abdominal aortic aneurysm, pancreatic tumor, retroperitoneal lipoma, fibroma or sarcoma, neurogenic sarcoma, kidney or adrenal tumor, mesenteric cyst. Most of these conditions will be diagnosed from the concomitant symptoms and signs, and, as will be pointed out, by their failure to re-

spond to moderate doses of x-ray irradiation.

In various clinics, and here at Bellevue Hospital, radiation therapists have used the therapeutic test of irradiation to differentiate roughly between a radiosensitive tumor and one that does not respond to irradiation. Reynolds and Leucutia (9) have described a therapeutic test with high-voltage and supervoltage x-rays in an excellent paper, in which all tumors of the mediastinum are placed in four different groups depending on their radiosensitivity. The lymphoblastomas discussed in the present paper fall into groups I and II of that classification.

It is hereby proposed to control the therapeutic test with more care, observe the results with more frequent roentgenographic and physical examinations, and carry it out to a greater degree than has been done heretofore, for the purpose of differentiating between the various types of lymphoblastoma.

The following routine is suggested as applicable to a mediastinal mass, and transposable to an abdominal mass:

1. Pre-radiation x-ray film with measurement of size of mass.

2. *First day:* 300 r measured in air, directed towards the tumor. Factors: 200 kv., 20 ma., 0.5 mm. Cu + 1.0 mm. Al, T.S.D. 50 cm.

3. *Second day:* 300 r.

4. *Fifth day:* X-ray film with measurement of the mass. If the mass has decreased appreciably in size (25 per cent or more), a presumptive diagnosis of either giant follicular lymphadenopathy or of lymphosarcoma is made. Therapy is continued, at the discretion of the therapist, to deliver a tumor-killing dose. Only time will tell the exact diagnosis. If the tumor reappears, or if a tumor appears elsewhere, the chances are that the diagnosis is lymphosarcoma. If the condition is permanently controlled, the diagnosis remains either giant follicular lymphadenopathy or localized lymphosarcoma.

It may be stated that an undiagnosed aleukemic form of leukemia with mediastinal mass will respond much the same way at this stage of the test. It is most likely, however, that at this time the blood picture will be altered and hence make the diagnosis more evident. Therapy can be then continued as indicated by the individual variations of the case.

5. If the mass shows no regression in five days, therapy should be continued at the rate of 200 to 300 r per day, an x-ray film being taken every three days. Anterior and posterior ports may be used. If the mass begins to show regression when 1,200 to 2,000 r have been delivered, a presumptive diagnosis of polymorphous-cell sarcoma is made. Therapy is continued at the discretion of the therapist.

6. If as much as 2,000 to 3,000 r are required to cause a 25 to 50 per cent decrease in the size of the tumor, a presumptive diagnosis of Hodgkin's disease is made.

7. If there is no response with 3,000 r,[3] then the tumor is radio-insensitive, and is probably one of those mentioned in the differential diagnosis. It should be remembered, however, that substernal thyroid, enlarged thymus, thyroid carcinoma, thymic carcinoma, fibrosarcoma, melanosarcoma, esophageal and bronchiogenic carcinoma, and sarcoid may show some degree of response to the higher dose.

The importance of the quantitative therapeutic test of x-ray irradiation lies in the evaluation of the prognosis, depending upon the response. With a presumptive diagnosis of giant follicular lymphadenopathy, the prognosis for life is reasonably good. If a presumptive diagnosis of localized lymphosarcoma is made, and the lesion is controlled by irradiation, it may be reasonable to offer a fair prognosis against early recurrence. A presumptive diagnosis of polymorphous-cell sarcoma, with control by irradiation, offers a longer period of life on an average than could be expected with Hodgkin's disease. If the

[3] These figures are based on the presumption that about 60 per cent of air dose reaches the tumor. Hence 3000 r air dose, even using several ports, should deliver about 1800 r into the tumor.

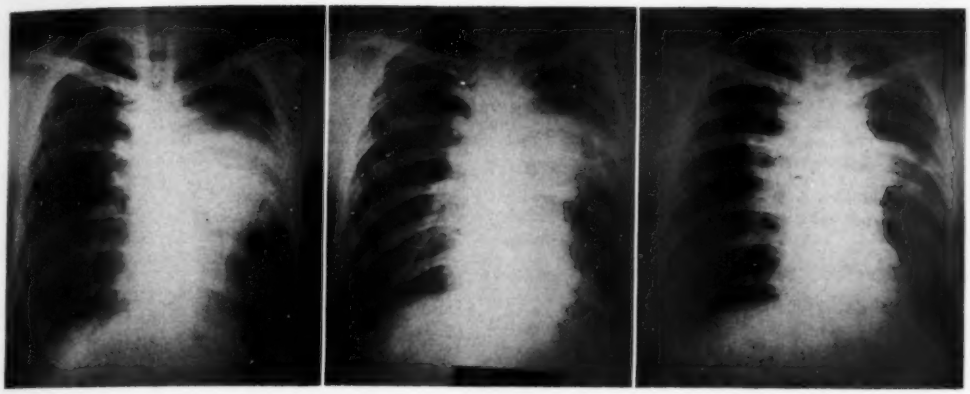

Fig. 3. A. Large globular mass extending from mediastinum and hilar region into left lung field.

B. Reduction of about 25 per cent in size of mass seventeen days after institution of therapy. Anterior port (10 × 15 cm.) received 1000 r; posterior port received 1,200 r.

C. Eight months later, the mass had diminished in size about 75 per cent. In the meantime the anterior and posterior chest received an additional 1000 r each, five months after the original therapy. Factors used were 200 kv., 20 ma., 50 cm. T.S.D., 0.5 mm. Cu + 1.0 mm. Al filter, H.V.L. 0.9 mm. Cu.

The patient was a 29-year-old white man first seen in our clinic in September 1939, with a history of a mass in the right neck of ten months' duration. Physical examination revealed enlarged cervical and axillary nodes and some hilar adenopathy. In July 1939, excision of three large nodes from the neck was done, and the pathological report showed Hodgkin's disease. In September and October 1939, the patient received 2,200 r to the right axilla, 1,200 r to the left axilla, 3,800 to right neck, 2,000 r to left neck, and 1,400 r to mediastinum. In December he received 800 r to the left axilla.

The patient was not seen from July 1940 until April 1945, when he presented himself with cough and dyspnea. Examination revealed a sensation of mass in the right upper quadrant, and a large mass in the left upper chest (A). Therapy was instituted as indicated above. The patient was last seen on July 30, 1946, at which time the chest film showed essentially the same picture as in C. He felt fine except for some nodular swelling of the left breast, which was thought to represent Hodgkin's involvement.

This case is presented to demonstrate, first, the relatively larger doses of radiation needed to bring about some reduction in a Hodgkin's mediastinal mass, and, second, to indicate the latent period before further reduction takes place. This is a plea to continue the therapeutic test until an adequate dosage has been delivered.

therapeutic test and subsequent clinical course indicate that the tumor is one of the other malignant neoplasms, the prognosis is invariably poor. Should the tumor be benign, as indicated by complete lack of response to irradiation and relative lack of symptoms or progress, then surgery may bring about a cure.

SUMMARY

1. The relative radiosensitivity of the lymphoblastomas has been discussed. Arranged according to sensitivity, they are:

A. Giant follicular lymphadenopathy.
B. Lymphatic leukemia.
C. Lymphosarcoma.
D. Polymorphous-cell sarcoma.
E. Hodgkin's disease.

2. The therapeutic test of irradiation has been discussed, and a plan submitted for a presumptive differentiation between giant follicular lymphadenopathy, lymphosarcoma, polymorphous-cell sarcoma, and Hodgkin's disease, when these diseases are predominantly limited to the mediastinum or abdomen, and no superficial lymph node is available for biopsy.

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Differential Diagnosis of Intracranial Neoplasms by Cerebral Angiography[1]

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IN THE DIAGNOSIS of intracranial tumor it is our aim to determine the site of the lesion and its histologic character. The first goal, so important for the surgical treatment, has been attained with a high degree of accuracy by the combined use of various diagnostic methods. The second postulate, viz., the preoperative recognition of the anatomic character of the lesion, is far more difficult to fulfill, yet it has considerable prognostic importance.

Intracranial angiography not only has proved to be a reliable method for the localization of cerebral tumors, but frequently furnishes information as to the pathologic-anatomic type of the neoplasm by demonstrating a specific vascular pattern. In this respect the method is decidedly superior to ventriculography.

Differences in vascularization of cerebral tumors have been known to neuropathologists and neurosurgeons for a long time and have recently been studied by advanced histologic methods (Hardman, 1). In certain neoplasms, differences of vascular design are of such gross nature that they can be demonstrated by angiography.

Egas Moniz (2–5) and his pupils were the first to point out the angiographic features of angiomas, meningiomas, and certain vascular gliomas. They also recognized a conspicuous absence of vascularity in cysts, abscesses, and cholesteatomas. Tönnis (6) and Hemmingson (7) described certain changes characteristic for glioblastoma. With increasing angiographic experience, a number of workers have studied the specific arrangement of blood vessels encountered in various types of intracranial neoplasms (Almeida Lima, 8; Lorenz, 9; Egas Moniz, 10; Riechert, 11; Engeset, 12).

In a series of 125 patients with intracranial tumor subjected to angiography at the University of Michigan Hospital, a special vascular pattern was observed in the following groups: angioma, meningioma, glioblastoma, certain types of astrocytoma. It must be emphasized here that a characteristic vascular pattern is not always to be found in such cases, but if it can be demonstrated it may be considered as almost pathognomonic.

ANGIOMA
(*8 Cases*)

Most of the lesions loosely designated as cerebral angiomas in reality are arteriovenous malformations. Although this group has been described in a previous communication (List-Hodges, 13), it will be discussed again to stress the features differentiating it from other intracranial lesions.

In *arteriovenous malformations* (6 cases), one or several enlarged and unusually tortuous arteries lead to a tangle of smaller vessels forming a more or less well defined mass (Figs. 1 and 2). From this angiomatous malformation one or more greatly dilated and redundant veins emerge, carrying a mixture of arterial and venous blood (14, 15). The entire vascular malformation, including the venous connections, is shown during the arterial phase of angiography, since the contrast medium enters directly into venous channels through sizable arteriovenous connections within the angioma. Because of this rapid transit of blood, no filling is obtained during the venous phase.

Arteriovenous malformations are found most frequently to involve cortical vessels, especially the anterior or middle cerebral

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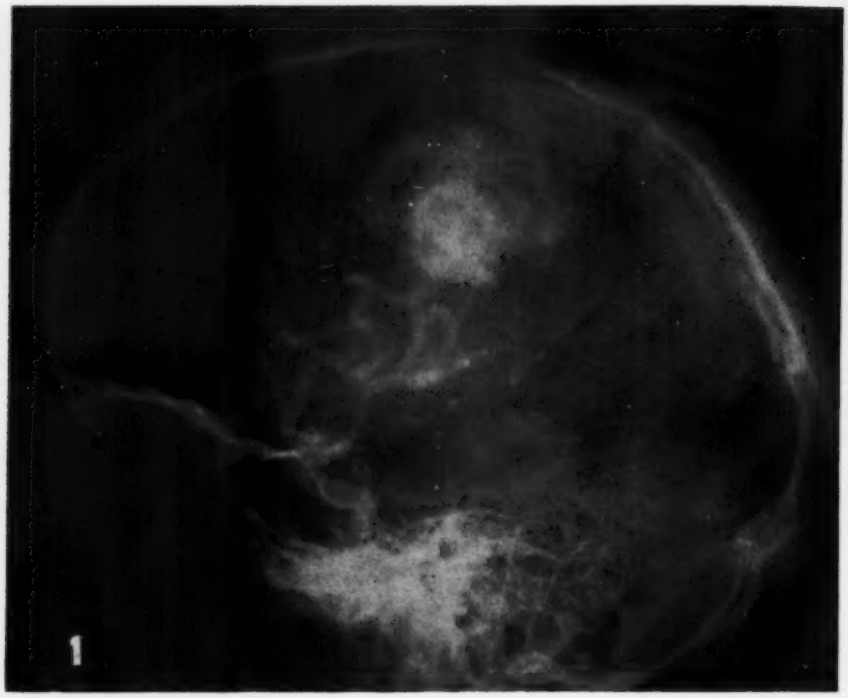

Fig. 1. Arteriovenous malformation of rolandic area. Lateral arteriogram. Simultaneous filling of enlarged arteries, capillary angioma, and huge efferent vein.

arteries, but they may also affect vessels supplying the interior of the brain (Wyburn-Mason, 16). Bilateral vascular anomalies have been observed (Egas Moniz, 17), particularly, when the lesion is situated close to the mid-line. It is worthy of mention that the internal carotid of the affected side is enlarged and tortuous and occasionally even cardiac enlargement and hypertrophy can be demonstrated (14). In contrast to true neoplasms, even large arteriovenous malformations do not displace the uninvolved cerebral vessels; this is clearly demonstrated on the anteroposterior projection by the absence of midline shift of the anterior cerebral artery. Furthermore, angiomatous vessels are far more bizarre in size than those encountered in vascular neoplasms.

Cavernous angiomas of the brain without associated vascular malformation are usually of small size and of rare occurrence. Our angiographic experience with this type of lesion has been inconclusive and limited to two cases. In one observation the patient suffered from jacksonian seizures and skull x-rays revealed an area of calcification in the frontal region. Angiography was disappointing in that it failed to show any specific vascular alteration. Operation and histologic examination of the excised tissue proved the lesion to be a small cortical cavernous angioma.

In the other case, massive hemorrhage had occurred into a small angioma, producing the clinical picture of right hemiparesis and aphasia. Here, too, angiography was unsatisfactory and, because of the hemorrhage, merely revealed evidence of a space-occupying lesion. Operation disclosed what looked like an encapsulated, partially organized subcortical hemorrhage. In both observations, the pre-existing angiomatous spaces may have been obliterated by clotted blood or thrombosis and, therefore, failed to become visible on angiograms.

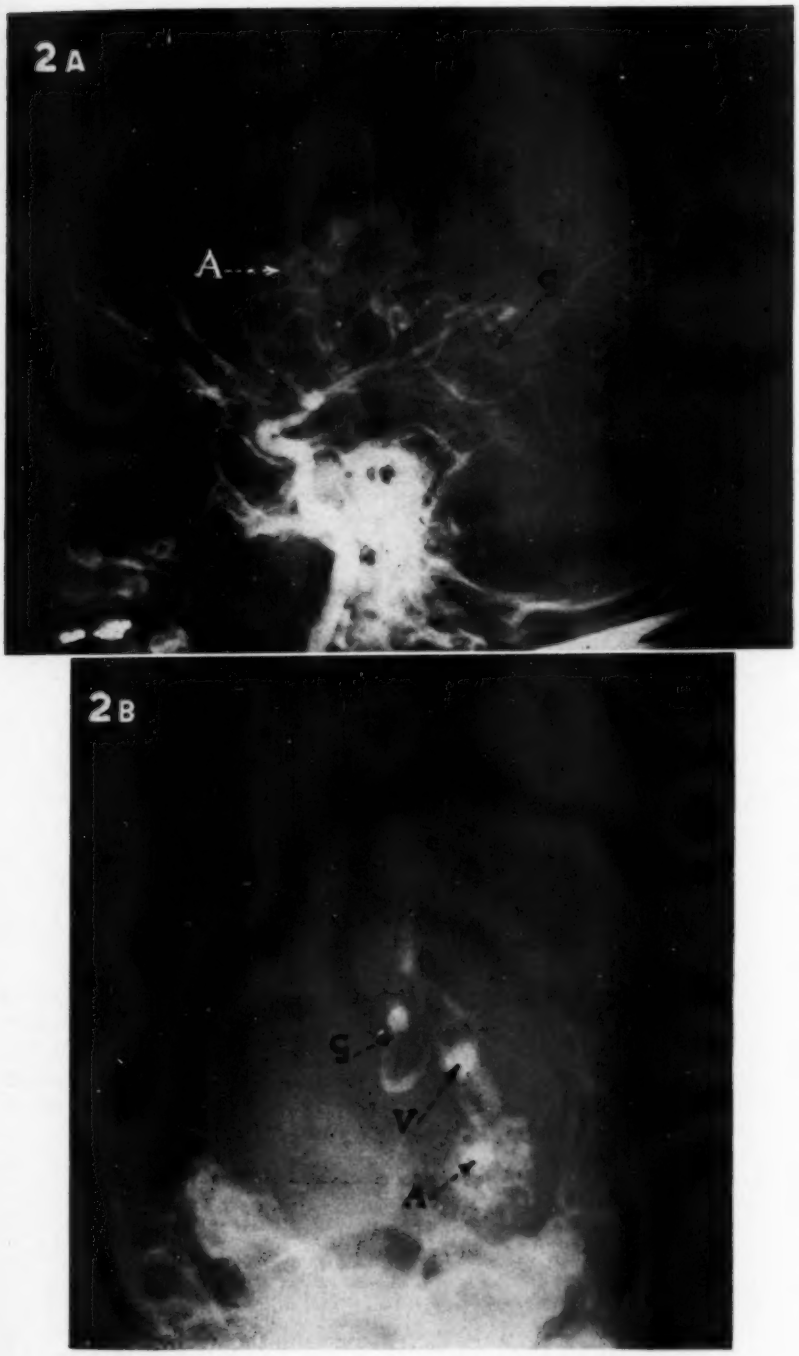

Fig. 2. Arteriovenous malformation of the anterior cerebral system. Lateral (A) and anteroposterior (B) arteriograms. An angioma composed of small vessels (A) drains into a large varix (V), which is connected with the vein of Galen (G).

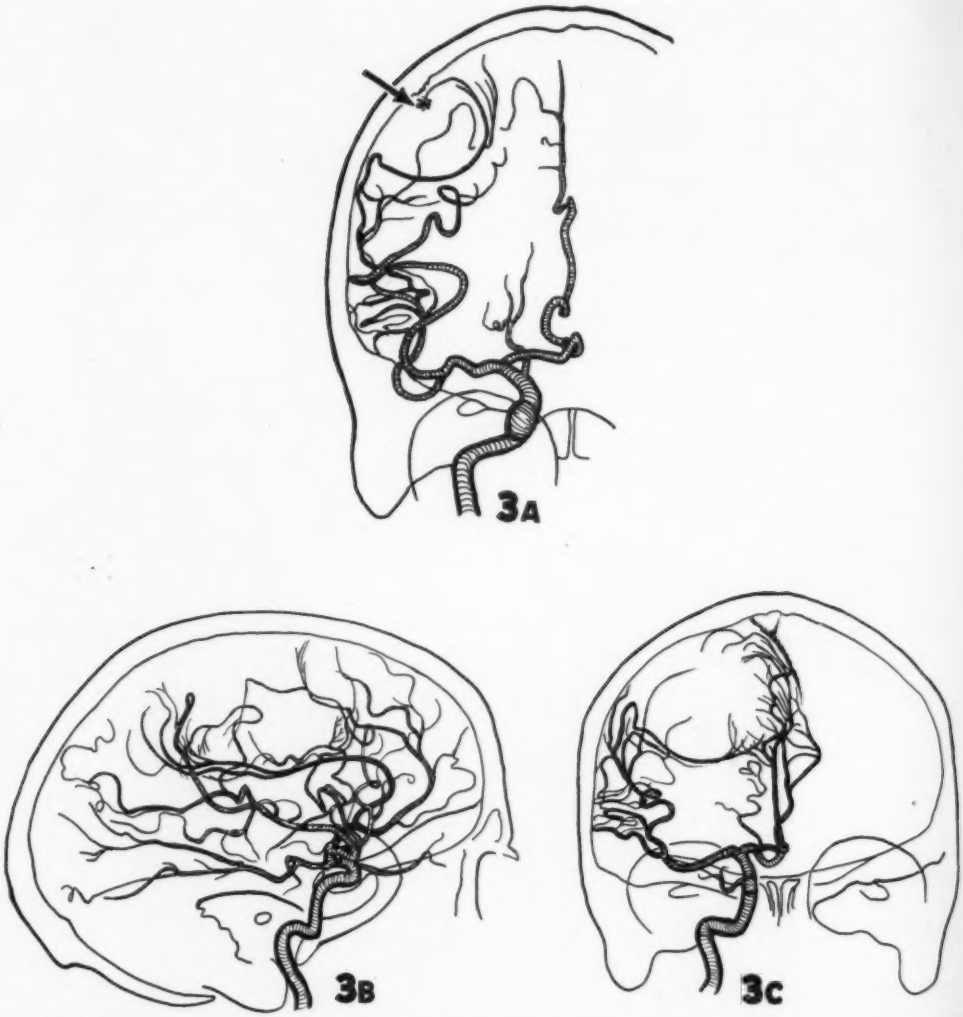

Fig. 3. Arteriograms of meningiomas (line drawings) showing the characteristic type of vascular displacement. A. Anteroposterior arteriogram of small parietal meningioma. Arrow points to dural attachment of tumor. B and C. Lateral and anteroposterior arteriograms of a parasagittal anterior parietal meningioma.

Intracranial *angioblastomas* occur almost exclusively in the cerebellum (if one disregards the angioblastic meningiomas, to be discussed below). We have had no occasion to examine this type of lesion by angiography.

MENINGIOMA
(*20 Cases*)

The meningiomas possess characteristic features which make them particularly suited for angiographic diagnosis (3–5, 8–12). Since they are demarcated, often globular tumors, located at the surface of the brain, they cause circumscribed deformities of adjacent cortical vessels. The cortical arteries in contact with the tumor appear to be distended and separated from one another, whereas the arteries of the adjacent compressed brain are crowded together and form a concentrically arranged corona around the lesion. Although local-

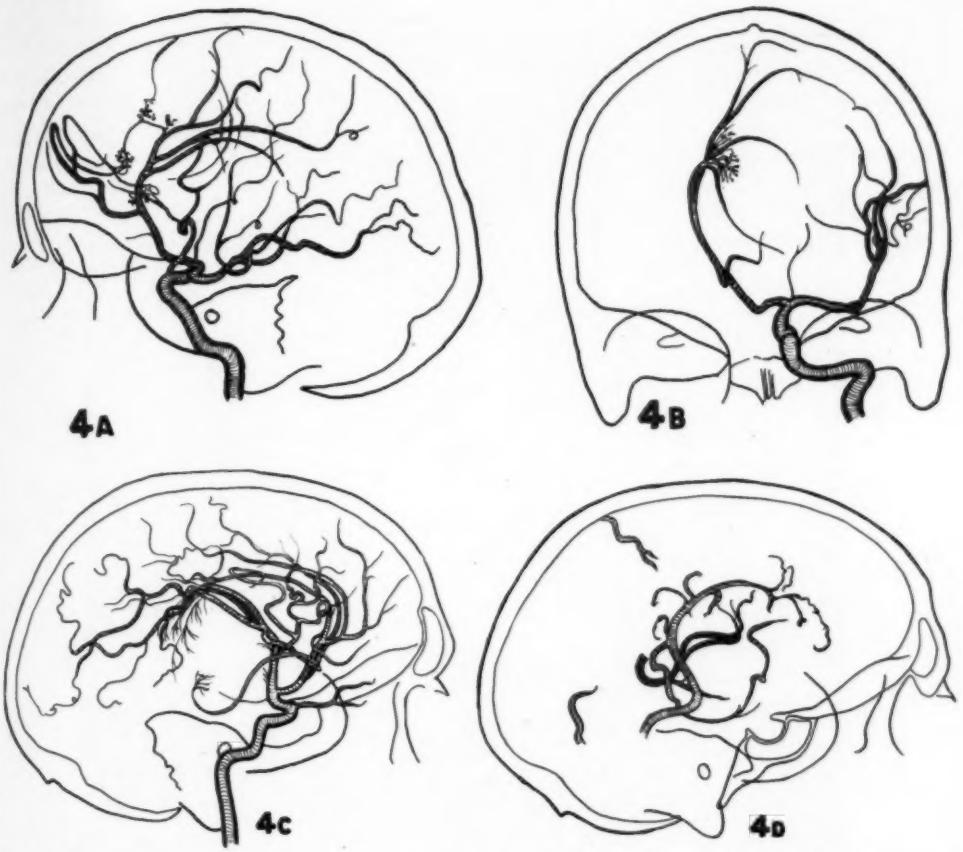

Fig. 4. Angiograms of meningiomas (line drawings) showing the characteristic mode of vascular displacement and special blood supply. A and B. Lateral and anteroposterior arteriograms of a parasagittal frontal meningioma. Note fine "flower spray" arteries on the surface and attachment of the tumor. C and D. Lateral arteriogram (C) and venogram (D) of meningioma of the lesser sphenoidal wing. Fine brush-like arteries supply the surface and attachment of the tumor. Note characteristic arrangement of surrounding veins.

ized displacement of cortical vessels is found in various types of space-occupying lesions, a probable diagnosis of meningioma can be made when cortical arteries are seen to be displaced away from the inner table of the skull. In frontoparietal meningiomas of the convexity, this may be clearly shown by anteroposterior arteriograms which, indeed, present an optic cross section of the lesion (Fig. 3, A and C). In meningiomas of the olfactory groove, on the other hand, the characteristic manner of arterial displacement is best seen on the lateral arteriogram (Fig. 9, A).

Meningiomas possess a rich blood supply derived from two different sources (Almeida Lima, 8): (1) from the external carotid system and (2) from the internal carotid (and vertebral) system (Fig. 5). The external carotid artery provides both an extracranial circulation for the tumor through the internal maxillary and superficial temporal arteries and a dural circulation through the meningeal (especially the middle meningeal) vessels. The supplying meningeal arteries are apt to be enlarged and tortuous; they end in a dendritic cluster of smaller vessels and form buds that perforate the bone at the dural attachment of the tumor. Frequently, this can be recognized on simple films of the skull since the meningeal vessels leave character-

istic negative imprints in the calvarium. A positive image of the dural blood supply of the tumor can be obtained by arteriography of the external carotid artery (Fig. 6, A). The method demonstrates not only the vascularization of the skull, but also the finer branches in the dura and neoplasm. The angiographic picture resembles that of the end-arborizations of a nerve in the motor end plate. Since the blood supply from branches of the external carotid artery, though variable in extent, is a typical feature of all meningeal tumors (meningioma and meningeal sarcoma), some authors (Almeida Lima, 8; Egas Moniz, 10; Riechert, 11) recommend routine angiography of the common or external carotid artery whenever a meningeal growth is suspected.

The second source of blood supply of meningiomas is the cerebral vessels which, depending on the location of the tumor, are derived either from the internal carotid or, less frequently, from the vertebral system. Arteriography of the internal carotid may show this circulation to the best advantage (Fig. 6, B). Besides the normal but displaced cortical arteries, one may observe one or multiple newly formed "tumor vessels," usually rather small arteries, splitting up into fine branches within the substance of the meningioma. The angiographic appearance of these vessels (Fig. 4) has been compared with a paintbrush or a flower spray (Egas Moniz, 2; Lorenz, 9). Characteristic for meningiomas is the formation of large veins which collect the blood at the tumor capsule and drain into adjacent cortical veins or dural sinuses. On venograms following carotid injection, large but short veins with many tributaries appear to outline the circumference of the growth in a garland or claw-like fashion, with the larger veins being situated in grooves and depressions between nodules of the tumor surface. The veins of the tumor can be distinguished from normal cortical veins by the abnormal course, large caliber, but short length (Figs. 4, D and 8, B).

Finally, a typical feature of meningioma

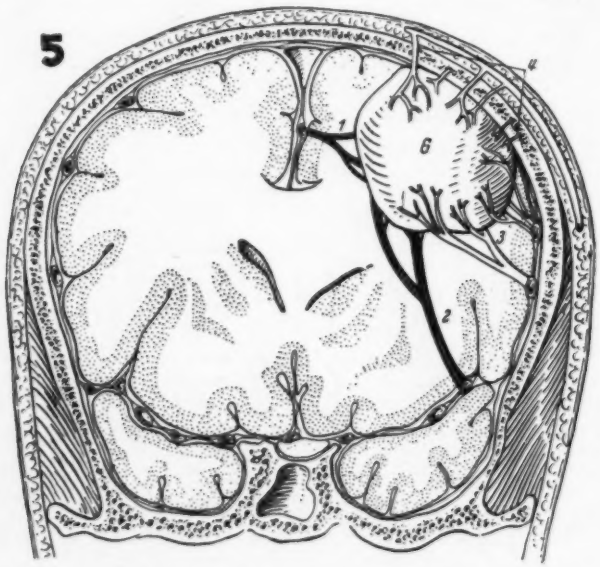

Fig. 5. Diagram to show the double blood supply of meningioma, reproduced from Egas Moniz. The vessels shown in black are arteries of the internal carotid system (1, anterior cerebral; 2, middle cerebral). Those in white are arteries of the external carotid system (3, middle meningeal; 4, superficial temporal artery). G. Tumor.

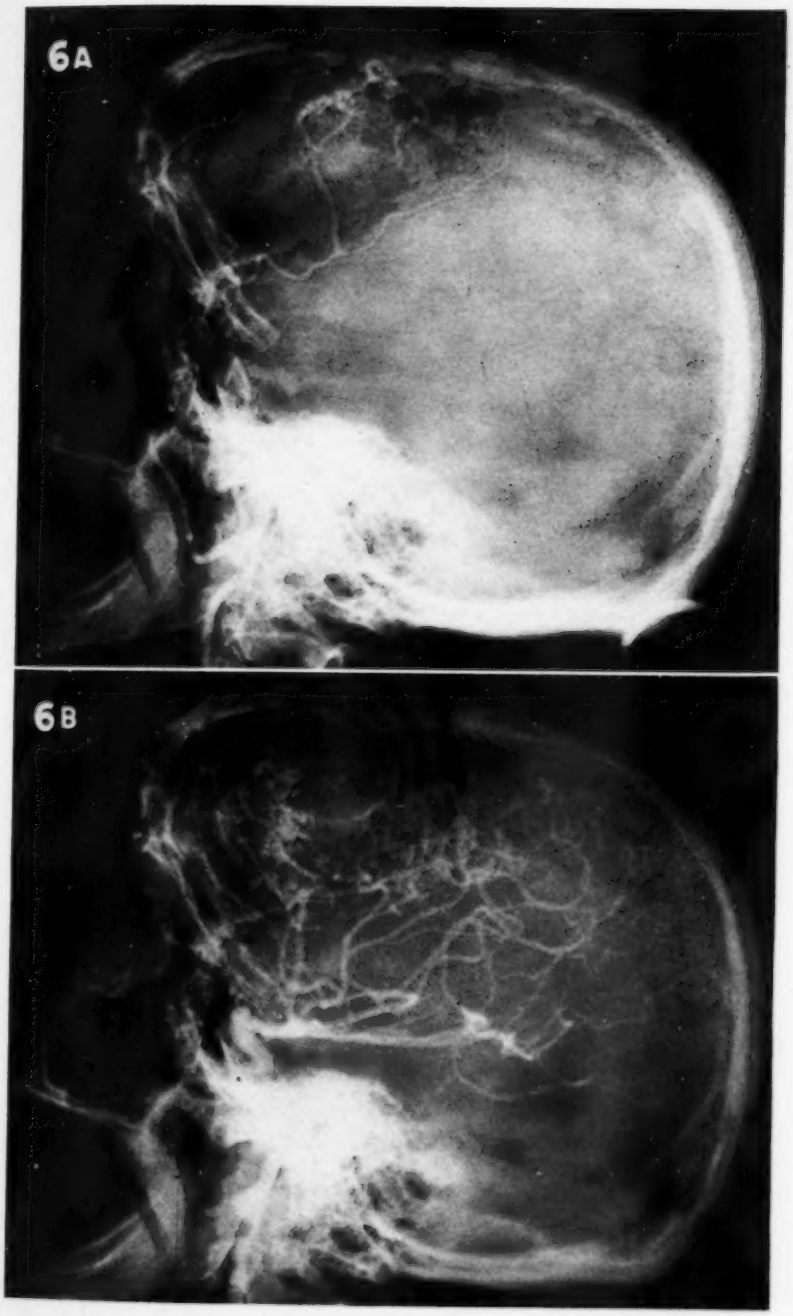

Fig. 6. Arteriograms showing the double circulation of a vascular frontal meningioma. A. Lateral arteriogram obtained by external carotid injection, demonstrating the circulation of the scalp, calvarium, and dura. B. Lateral arteriogram obtained by internal carotid injection, showing unusually rich vascularization of the tumor. Note also typical displacement of cerebral vessels.

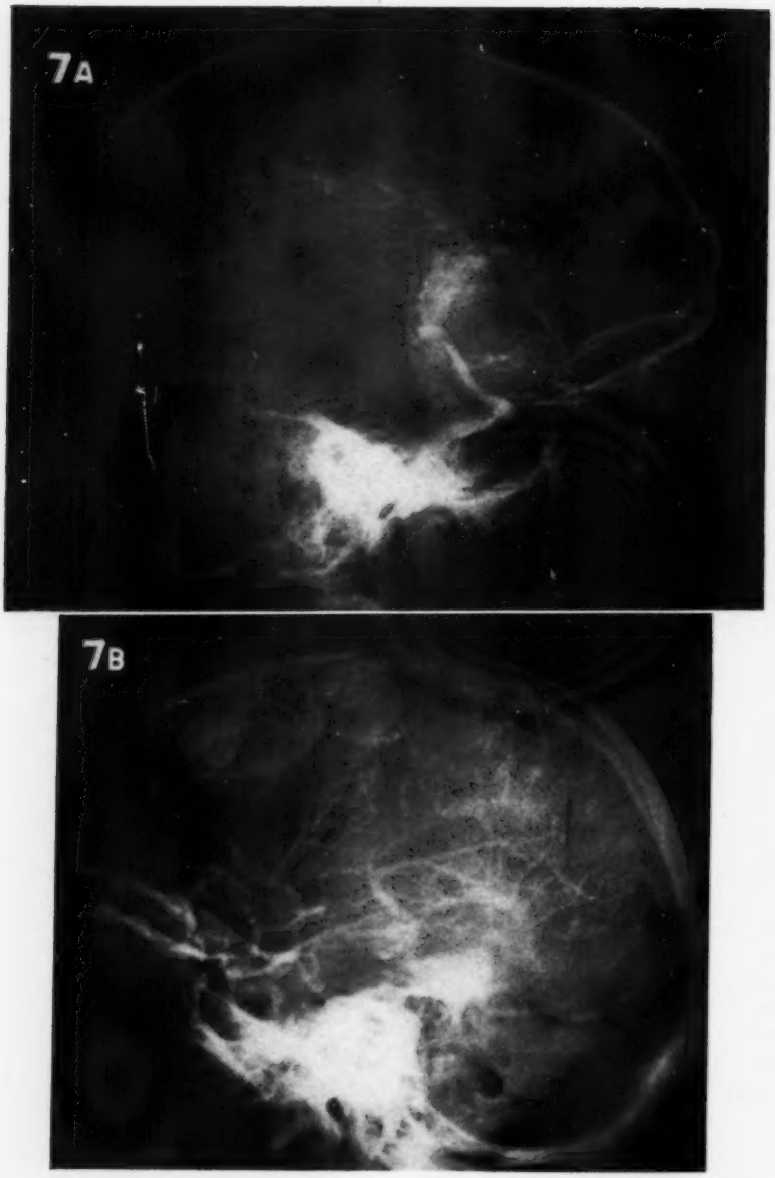

Fig. 7. Demonstration of the special capillary pattern in meningioma during the arterial phase. A. Lateral arteriogram of vascular meningioma of the lesser sphenoidal wing. B. Lateral arteriogram (common carotid injection) of frontal parasagittal meningioma.

is the demonstration of a special vascular network consisting of vessels of capillary or nearly capillary size. In such cases, angiography demonstrates diffuse, uniform, or slightly mottled opacification, silhouetting parts of the tumor or even the entire growth (Figs. 7, 8 B, and 9). The x-ray contrast between tumor tissue and brain is explained by the fact that the capillary circulation within the meningioma is both denser and

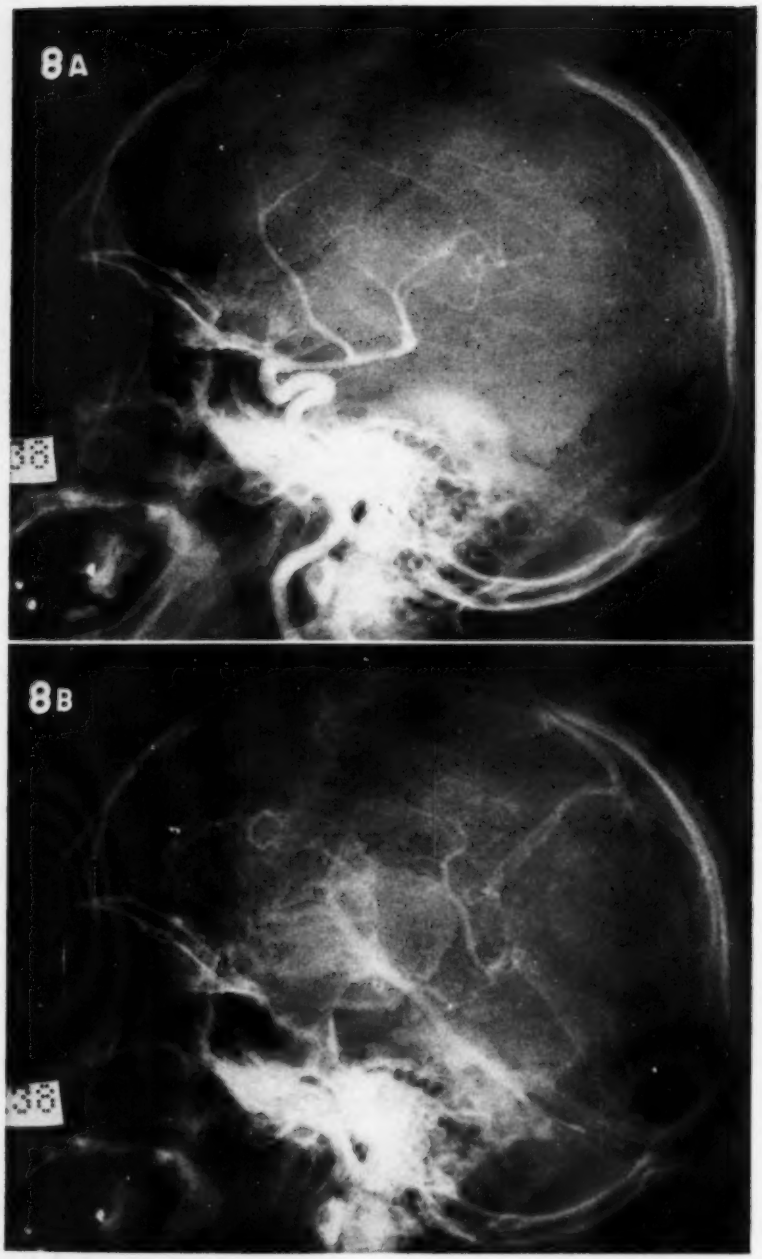

Fig. 8. Comparison of arteriogram and venogram in a meningioma of the lesser sphenoidal wing. A. Lateral arteriogram, showing typical displacement and special vessels at attachment of tumor. B. Venogram, showing characteristic pattern of veins and diffuse capillary shadow of tumor.

slower than that of the brain, thus producing a local accumulation of contrast material. As Egas Moniz (5, 10) pointed out, in vascular meningiomas near the carotid siphon, *e.g.*, those of the lesser sphenoidal wing, the diffuse radiopacity may become visible during the arterial phase, *i.e.*, one to one and a half seconds after the beginning of the injection; meningiomas of other location usually show the capillary shadow a little later, *viz.*, in the venous phase, three to five seconds after the injection. In one case of an exceptionally vascular meningioma, we observed an irregular plexiform pattern of small vessels during the arterial phase instead of a diffuse opacification (Fig. 6, B). Such a picture is similar to the arteriograms of true angioma or vascular glioblastoma (see below).

GLIOBLASTOMA

(*55 Cases*)

Glioblastoma is an infiltrating neoplasm which may show a certain degree of demarcation. Some glioblastomas are relatively avascular and contain large areas of necrosis, others exhibit excessive vascularization by poorly formed or pathologic blood vessels. Considerable brain edema is a common feature. All these anatomic characteristics can be recognized in angiograms of glioblastoma.

Due to the infiltrating manner of growth, displacement of cerebral vessels tends to be more diffuse and less profound than is the case in meningiomas of comparable size. Associated edema of the brain is responsible in a large measure for marked vascular displacement. This may give the observer an exaggerated impression of the size of the neoplasm.

The peculiar vascular pattern within glioblastoma is virtually pathognomonic of this neoplasm. Unfortunately, this characteristic vascularity cannot be shown in all cases by angiographic methods. Lorenz (9) found 24 of 45 cases of glioblastoma with a special circulation (53 per cent). In Hemmingson's (7) material the incidence was at least 64 per cent; in our own material the incidence is lower—40 per cent or 22 cases in 55.

For a better understanding of the angiographic findings, it is important to review the vascular structures as shown by histologic methods. Hardman (1) distinguished four different zones in glioblastoma (Fig. 10, A). In the *first* zone containing brain tissue adjacent to the neoplasm, the normal vascular pattern is well preserved. The capillaries may be dilated and occasionally form complex loops. In the *second* zone, representing the actively growing, invasive edge of the tumor, the normal angioarchitecture is disrupted. Adjoining capillaries undergo "glomeruloid" changes, consisting of localized dilatations resembling aneurysms and tufts of endothelium which are directed toward the center of the tumor (Fig. 10, B). In addition, one observes large sinusoid vessels which presumably have developed from dilated capillaries. In the *third* zone, comprising the deeper though viable parts of the tumor, the sinusoids become larger in size but fewer in number; they tend to undergo thrombosis by adventitial thickening and proliferation of the endothelium of the intima. The *fourth* (central) zone of the tumor contains areas of necrosis, cysts, and fibrous tissue. All blood vessels are thrombosed and hyalinized.

The observable angiographic changes occur in the viable periphery of the neoplasm (the second and third zones), which measures 3 to 30 mm. in thickness. The characteristic vascular pattern is produced mainly by the sinusoids, perhaps also by the "micro-aneurysms." In contrast to meningioma, the blood vessels of glioblastoma are poorly formed and irregular; on angiograms they may appear blurred; usually they cannot be traced over long distances and contain contrast medium in a variable degree of concentration.

It has been stated that direct arteriovenous communications exist in glioblastomas because at operation the veins of these tumors may be sometimes seen to contain arterialized blood (Olivecrona, 7), and arteriograms may show simultaneous filling

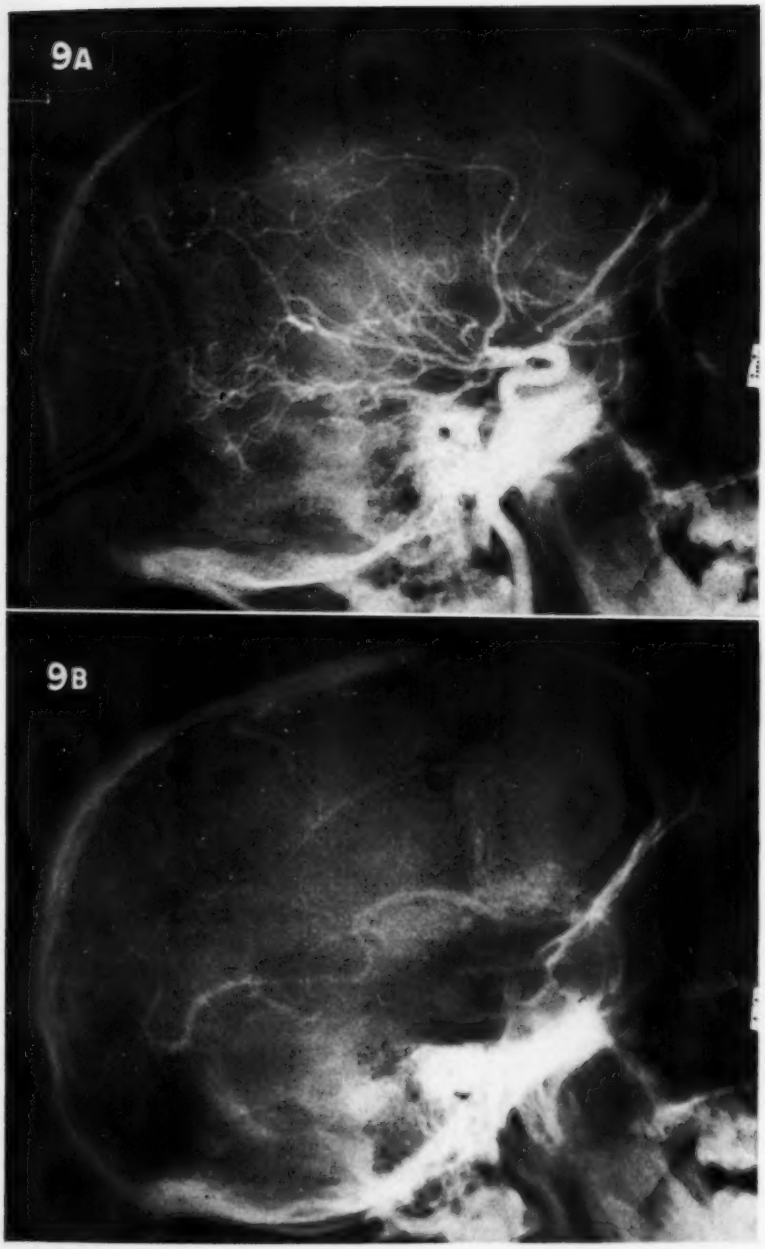

Fig. 9. Comparison of arteriogram and venogram in a sarcomatous meningioma of the olfactory groove. A. Lateral arteriogram, showing typical displacement and faint capillary shadow. B. Lateral venogram, showing dense capillary shadow of entire tumor.

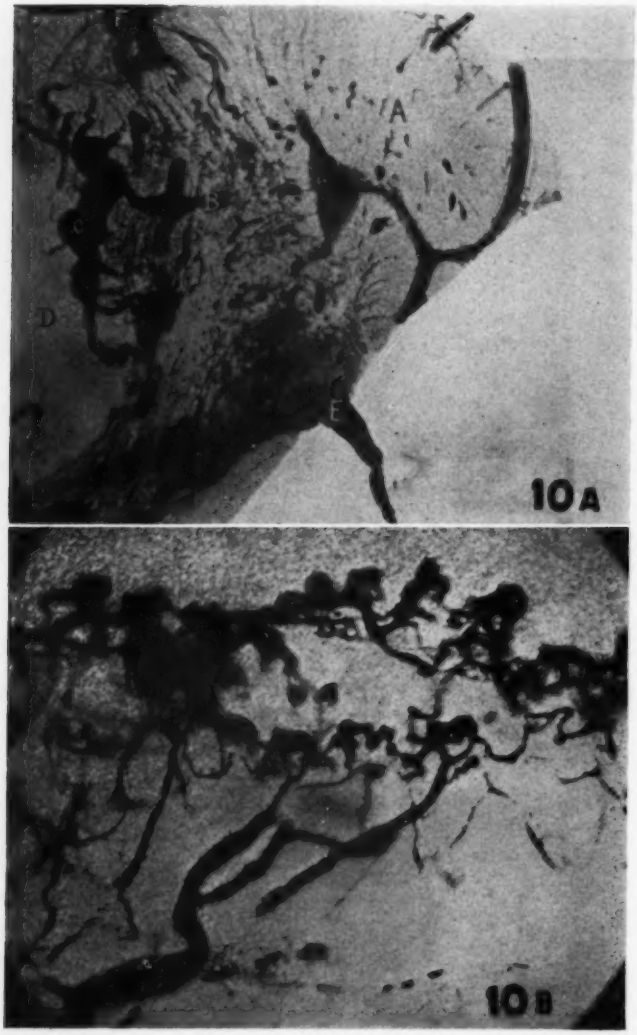

Fig. 10. Illustrations from Hardman's article on the "Angioarchitecture of the Gliomata." A. Roentgenogram. Section from a glioblastoma following vascular injection with barium paste. A. Zone of normal brain surrounding the tumor. B. Peripheral zone of tumor with irregular dilated capillaries and small sinusoids. C. Deep zone of viable tumor with large sinusoids. D. Necrotic avascular center of tumor. E. Anterior cerebral artery. F. One of the anterior cerebral veins.

B. Peripheral zone of a glioblastoma. Blood vessel stain. Aneurysm-like dilatations of capillary loops and draining venules.

of arteries and veins or even apparent arteriovenous connections (Tönnis, 6). Hardman, however, found no real arteriovenous anastomoses in his anatomic studies; he explains the above clinical observations by the fact that the capillary bed is tremendously dilated by the development of large sinusoids and that a considerable degree of short circuiting of blood probably occurs between pathologic vessels.

We have observed two types of special vascular pattern. In the *first* type, the

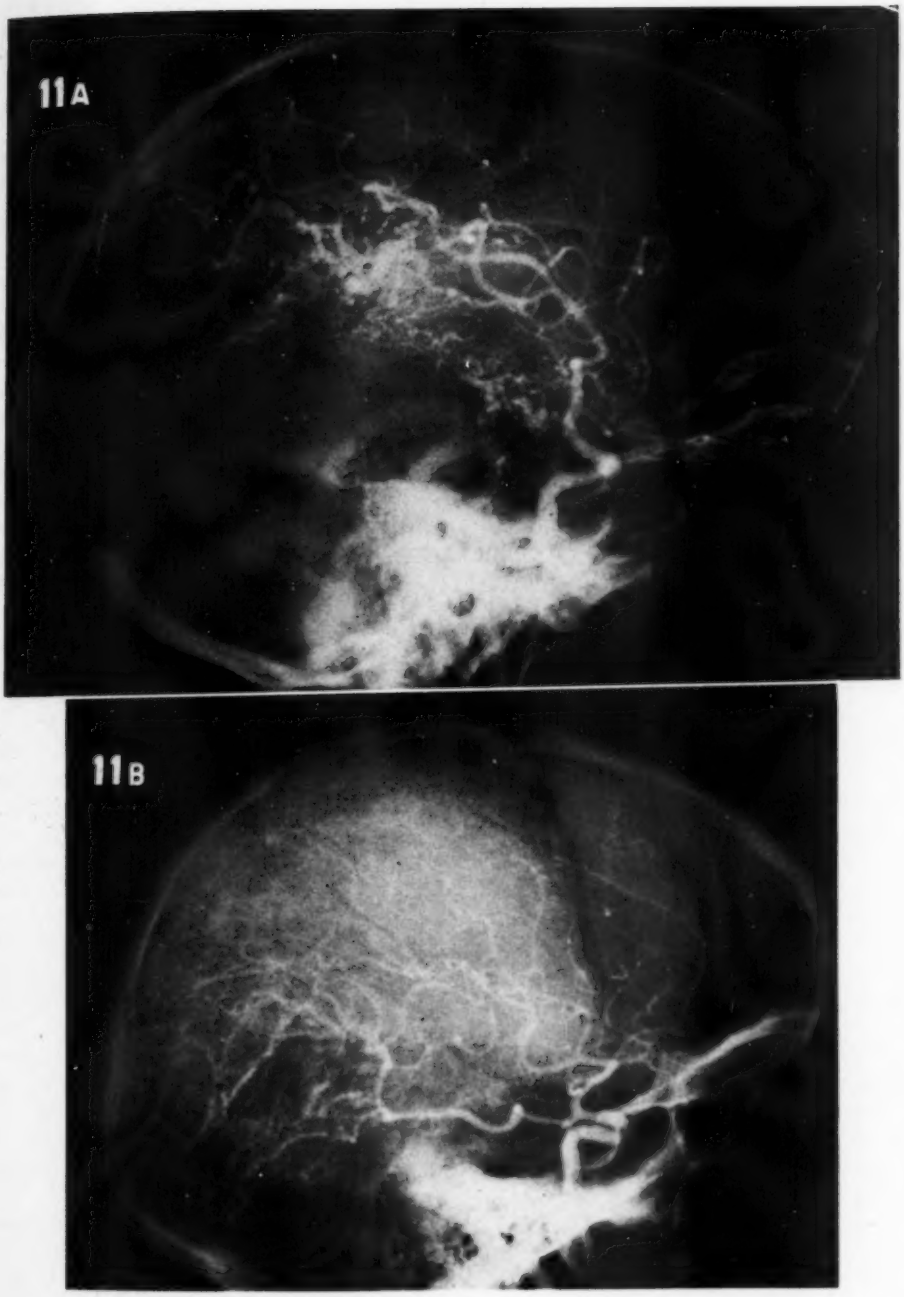

Fig. 11. Arteriograms of glioblastomas with characteristic vascular pattern. A. Temporoparietal glioblastoma with aneurysmal dilatations of small vessels. B. Lateral arteriogram of occipital glioblastoma with characteristic vascular pattern (sinusoids).

tumor exhibits an irregular network of fine crisscrossing vessels (Fig. 11, A). In addition, there may be a few larger sinusoid vessels which tend to form lacunar dilatations and produce spiral or corkscrew patterns (Fig. 11, A). The general vascular design may resemble the roentgenographic appearance of the normal lung, although it is more irregular and spotty (Fig. 11, B). Uniform capillary opacity, as seen in meningioma, is never found in glioblastoma. The *second* type of glioblastoma is characterized by a very coarse and bizarre vascular pattern which resembles that of an arteriovenous malformation (Fig. 12, A). Large malformed vessels, frequently of larger caliber than normal cerebral vessels, can be traced through the tumor. They may form spirals or arrange themselves in parallel layers (Egas Moniz, 2, 10). Some of these large vessels probably are huge sinusoids; others may be veins.

In contrast to the true arteriovenous angiomatous malformations, well defined afferent arteries and efferent veins are not seen in vascular glioblastoma; furthermore, there is always displacement of adjacent normal vessels by the bulk of the tumor. Since vascular glioblastoma has a necrotic or cystic center, its angiographic appearance (especially on stereoscopic films) is sometimes that of a sharply demarcated lesion covered by a peripheral plexus of vessels (Fig. 12, A). Such tumors possess considerable similarity to certain vascular meningiomas (Fig. 6, B), but scrutiny of the finer vascular texture will usually permit a differentiation. As a rule, the best pictures of the vascular pattern of glioblastoma are obtained in the late phase of the arteriogram, one and a half to two seconds after beginning the injection, but occasionally the abnormal vessels are better visualized in the initial venous phase.

ASTROCYTOMA
(*12 Cases*)

Astrocytoma of the cerebral hemispheres frequently is an extensive growth diffusely infiltrating the white matter. Judged from its gross appearance, parts of a hemisphere or even an entire hemisphere may be diffusely enlarged and of increased consistency, sometimes without other significant macroscopic changes. There is a tendency to interstitial liquefaction and formation of cysts. The supply of blood is relatively scanty in astrocytoma and is not demonstrated too well by either angiographic or histologic methods. According to Hardman (1), the capillary pattern in astrocytoma is not so grossly disrupted as in glioblastoma; the capillaries show increase in number, irregularity, and reduplication, without significant dilatation. Correspondingly, the angiographic examination of astrocytoma reveals extensive stretching and spreading of the larger and medium-sized cerebral arteries. The finer arterial branches, however, which are always visible on the normal arteriogram, may be entirely absent (Fig. 12, B). It may be assumed that the neoplastic infiltration separates and distends the vessels and even prevents their filling with contrast material. The frequent presence of cysts may be another factor to account for sparseness of blood vessels. It is worthy of mention that the angiographic picture of brain edema resembles that of diffuse astrocytoma, but is far less marked in degree.

We agree with Hemmingson (7) and Engeset (12) that a special (increased) circulation is decidedly uncommon in astrocytoma. We observed in only two instances a fine brushwork of small vessels within the tumor (in one case in the arteriogram, in the other in the venogram). We disagree with Egas Moniz (10), who considered the presence of localized lacunar vascular dilatations a characteristic sign of astrocytoma. Most authors (7, 12) believe that such changes are observed in mixed gliomas, *i. e.*, astrocytoma verging to astroblastoma or glioblastoma; at any rate, they appear to indicate malignant propensities and are not germane to "benign" astrocytoma.

OTHER TYPES OF INTRACRANIAL NEOPLASMS

Up to the present, our own experience with angiography in patients with brain

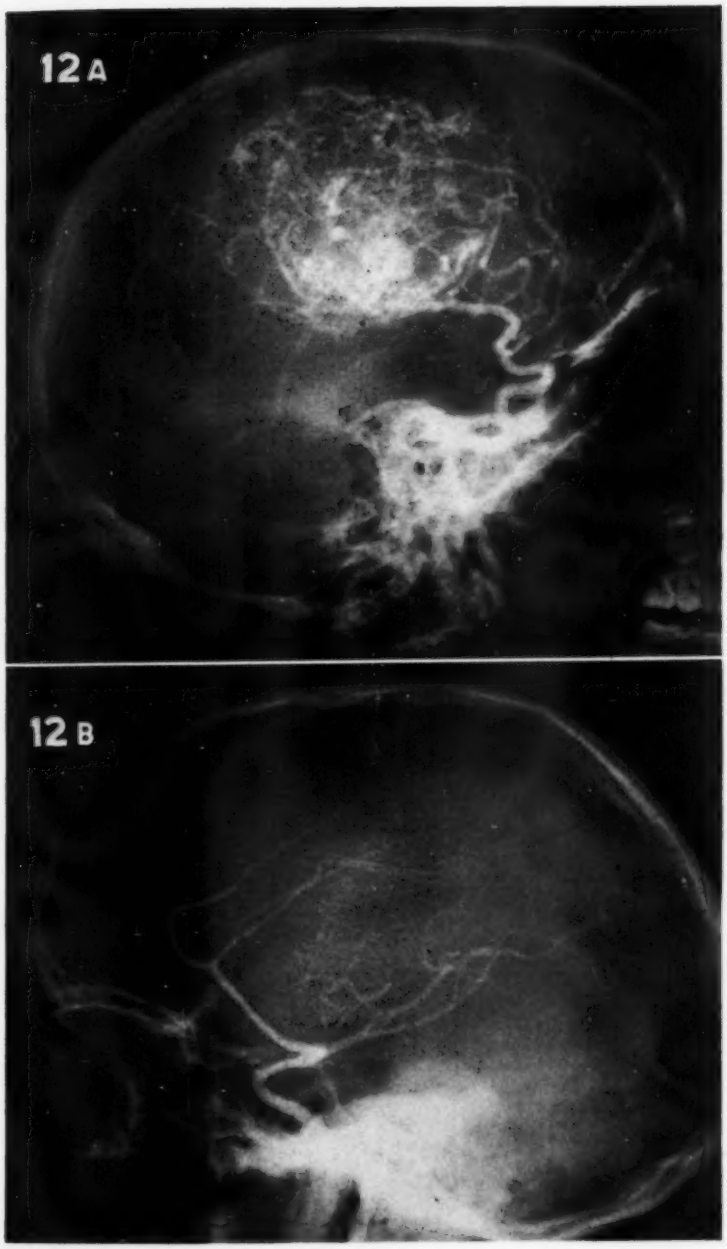

Fig. 12. A. Frontoparietal glioblastoma with very coarse vascular pattern. The rounded, sharply demarcated appearance is due to a large cyst in the tumor. Note resemblance to vascular meningioma (Fig. 6, B). B. Lateral arteriogram of diffuse frontal and parietal astrocytoma. Note avascularity and diffuse stretching of arteries

tumors has not been sufficiently large to describe a specific vascular pattern in certain of the rarer types of intracranial neoplasm. According to Hemmingson (7), Egas Moniz (10), and Engeset (12), oligodendrogliomas behave like astrocytomas and usually possess no special circulation. Metastatic carcinomas may show increased vascularity, resembling glioblastoma. In meningeal sarcoma, Lorenz (9) observed a rich double circulation from the internal and external carotid arteries and also arteriovenous anastomoses. Little is known about the angiographic appearance of ependymoma, pinealoma, and medulloblastoma.

Undoubtedly, preoperative knowledge of the vascularity of a lesion is very helpful to the neurosurgeon. It facilitates the plan of surgical attack in angiomas and meningiomas. With a definite diagnosis of glioblastoma established by angiography, surgery might not be undertaken at all in view of the hopeless prognosis.

SUMMARY

Cerebral angiography was performed in a series of 125 patients with verified intracranial tumor. In cases of angioma, meningioma, glioblastoma, and diffuse astrocytoma, the angiograms often are so characteristic as to permit a preoperative anatomic diagnosis.

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Familial Osseous Atrophy[1]

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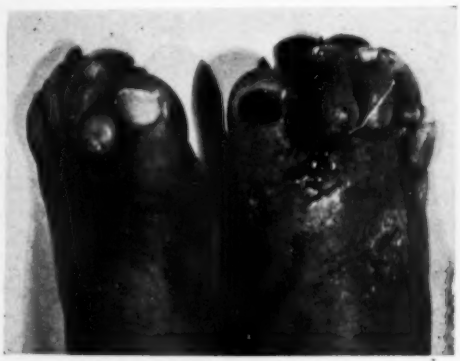
University, Va.

THE OBJECT OF this report is to introduce into the radiological literature familial osseous atrophy. The condition was first described by Smith (1), in 1934; its etiology is still unknown.

Our patient, a white male, age 25, was seen at the University Hospital on July 18, 1941, complaining of chronic ulcers on the plantar surfaces of both feet. Three years before, thick callus had appeared under the heads of the first and second left metatarsals, associated with moderately severe aching pain following long periods of standing. Similar changes developed on the right foot shortly afterward. When the callus had been present several months, it blistered and sloughed, leaving large ulcers (Fig. 1). These healed when the patient stayed off his feet, but recurred when he got up again. On several occasions, bits of bone were extruded from the ulcer craters.



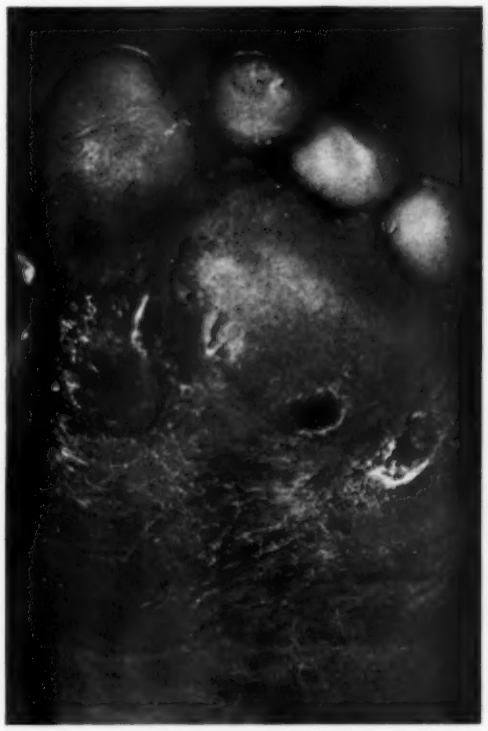
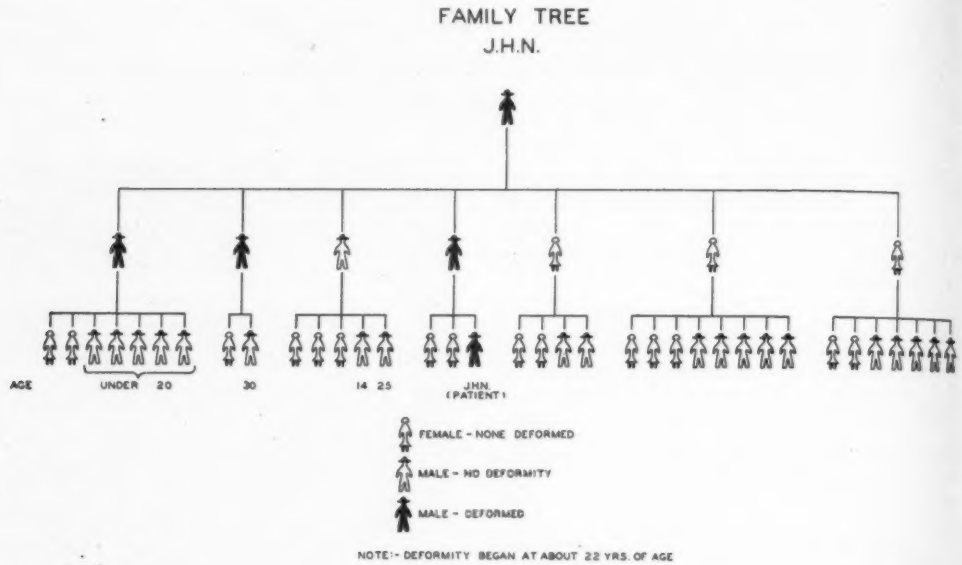


Fig. 1. Chronic crusted ulcers which were present on both feet associated with localized hyperemia and swelling. Shortening of first digits, bilaterally, due to loss of bony substance.

On investigation of the family history, it was found that the patient's paternal grandfather had suffered from the same condition, beginning in his early twenties (see Family Tree). He had had recurrent ulcers with sloughing of small pieces of bone until the feet were practically gone. He died in his sixties. The father is similarly affected (Fig. 2) and, like the grandfather, has been reduced to crawling on hands and knees. At no time was any other portion of the body involved. Two uncles are affected (Fig. 3), but the patient is the only grandchild suffering from the disease.

On examination of the patient, both feet were found to be cold and clammy. The distal two-thirds were moderately swollen, tender, and livid. There was a draining crusted ulcer under the interspace between

[1] From the Departments of Roentgenology and Surgery, University of Virginia Hospital, and Department of Medicine, University of Virginia. Accepted for publication in July 1946.



the distal ends of the first and second metatarsal bones, bilaterally. Neurological examination revealed a loss of heat and cold sensation over the toes and hyperactive reflexes of the lower extremities. The pulsations of the dorsalis pedis and posterior tibial arteries were full and strong. There was a moderate bilateral inguinal lymphadenopathy. The remainder of the examination was essentially negative. The temperature, orally, was 99.2° and the pulse 88. An inguinal node was removed for biopsy and the report was "chronic lymphadenitis."

The patient signed out of the hospital against advice twenty days following admission, with the ulcers partially healed.

Four years later, Dec. 10, 1945, he was readmitted for further study. In the interval he had had recurrent ulcers on the plantar surfaces of both feet, with moderate pain, swelling, and increasing difficulty in walking. The ulcers were larger and the feet were markedly shortened (Fig. 4).

Tissue taken from the margins of the ulcers and a small piece of bone removed for biopsy were reported as showing

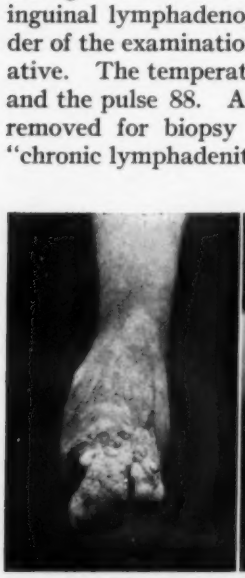


Fig. 2. Left foot of patient's father.

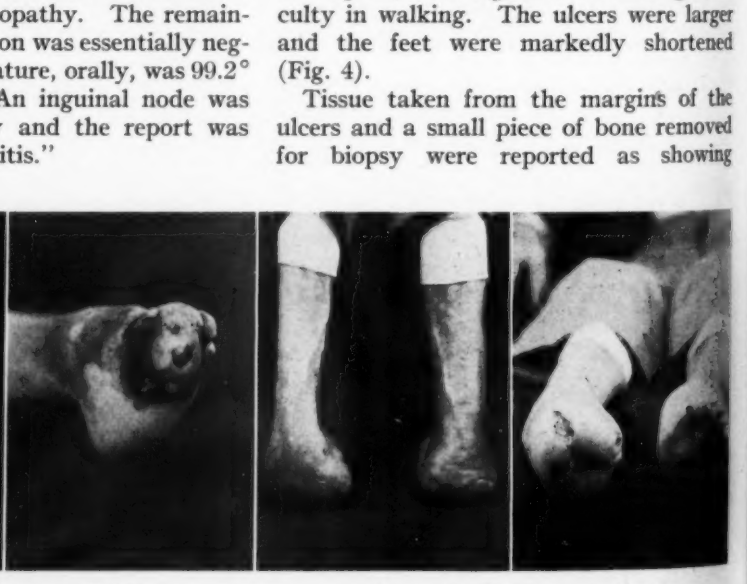


Fig. 3. Feet of patient's uncle.

chronic inflammatory changes in the soft tissues and atrophy of the bone.

Radiological examination at the time of the first admission revealed necrosis of the distal 4 cm. of the right first metatarsal bone (Fig. 6). The margin of the distal end of the remaining portion of the shaft was irregular, with multiple amorphous sequestra measuring from a few millimeters to a centimeter in diameter located about the first metatarsophalangeal joint. There was no periosteal reaction. The cortex was moderately decreased in density and the surface slightly irregular. There was no loss of trabeculation except in the inferior distal centimeter, where the bone had an amorphous appearance. There were similar changes in the proximal portions of the proximal phalanges of the first and second digits and in the distal centimeter of the fifth metatarsal. The phalanges showed moderate atrophy and a decrease in circumference. The soft-tissue shadows showed only the defect of the ulcer crater with slight thickening from edema. There were similar changes in the left foot, involving the same bones but to a lesser degree.

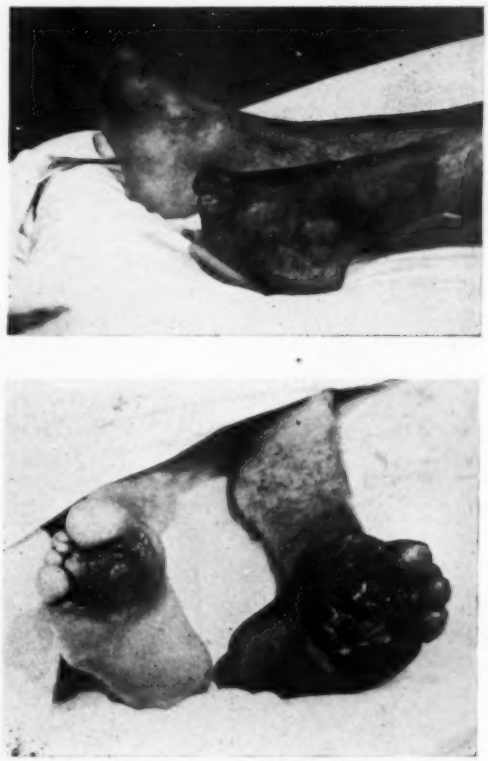


Fig. 4. Photographs made four years after the patient was first seen (Fig. 1), showing increase in size of ulcers and shortening of both feet.

On the patient's readmission to the hospital, four years later, there was complete absence of the metatarsal bones except for the proximal portions (Figs. 5 and 7). The remaining portions of the metatarsals were markedly atrophied. The distal ends of the naviculars, cuboids, and cuneiforms were absent. The remaining bones were moderately atrophic. On both occasions, the rest of the skeleton was normal in appearance.

The radiological findings were not those

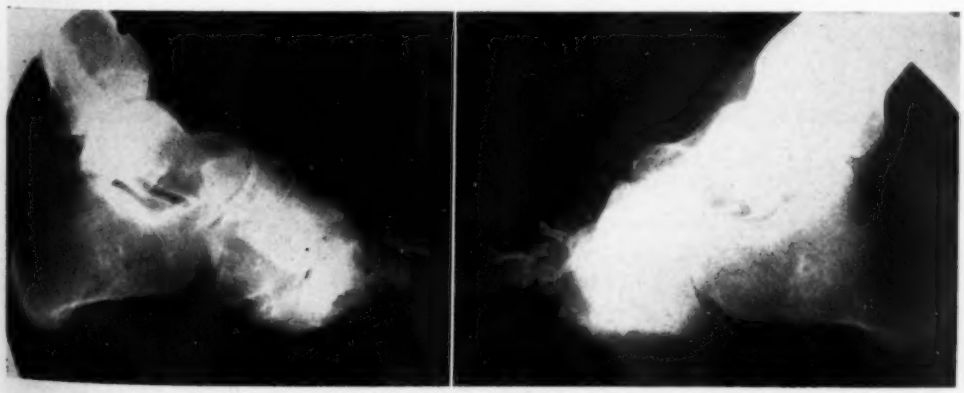


Fig. 5. Lateral views to show extent of shortening in four years.

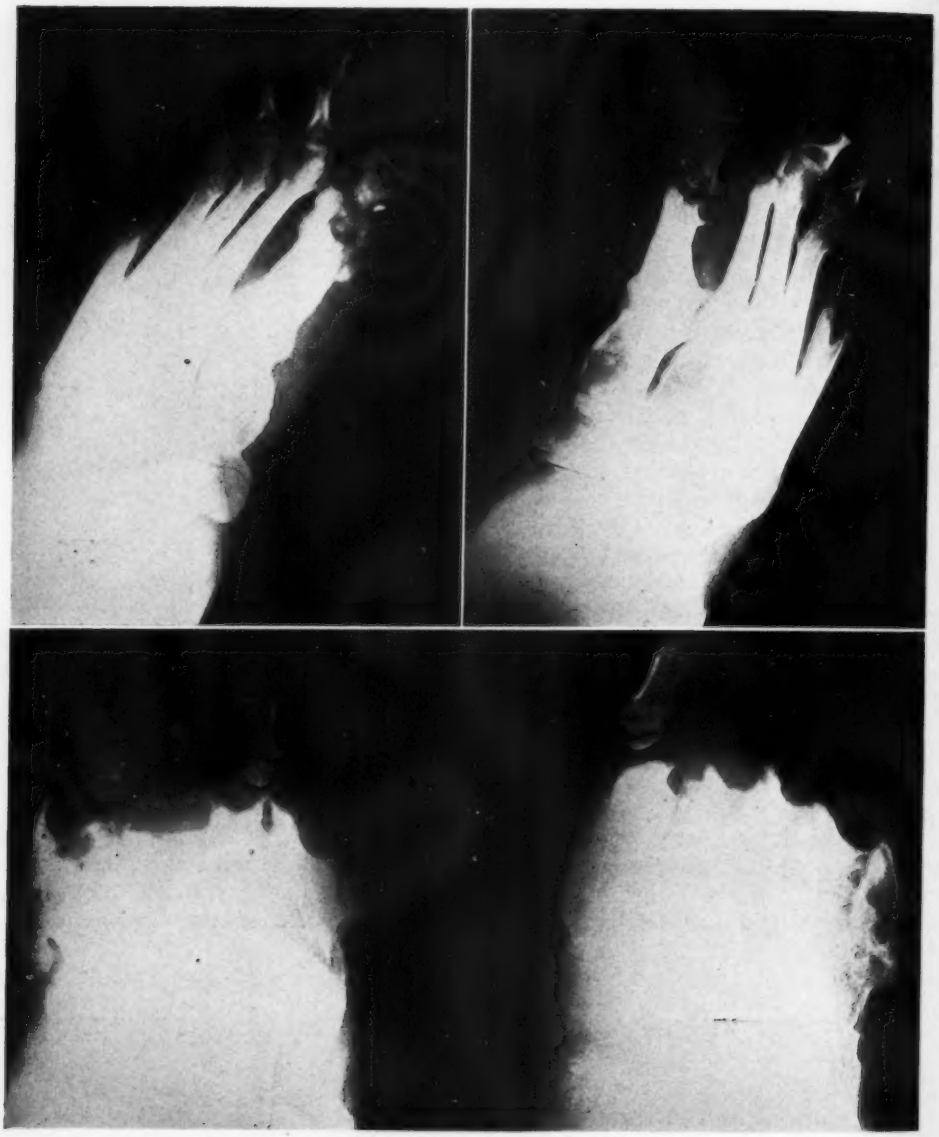


Fig. 6 (upper views). Bone atrophy and dissolution present on first admission.
Fig. 7 (lower views). Advancement of bone dissolution in four years.

of pyogenic infection. Such infections as tuberculosis and fungus disease were ruled out by repeated smears and cultures. Specimens from an ulcer margin and from bone were also studied to rule out leprosy and infection. Serological examination of the blood and spinal fluid was negative for syphilis. The blood calcium was normal. The only positive finding was a decrease in skin sensitivity to heat and cold which was localized to the distal portions of both feet. The pattern followed no definite outline of nervous innervation.

This case is similar in almost all respects to those reported by Smith (1) in 1934. Tocantins and Reimann (2) reported simi-

lar cases in 1939. In all, there was a definite history of familial tendency. In Tocantins and Reimann's group, several congenital defects were associated with the atrophy of the bones of the feet, which was not true in our case. In their group, also, both males and females were involved, while in the family considered here only males were affected. In all groups the onset was in early adulthood.

SUMMARY

Familial osseous atrophy, a disease of unknown etiology, follows a characteristic clinical course and presents characteristic radiological findings. It is progressive after onset and terminates in crippling of the victim. No deaths have been known to occur from this malady.

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Absorption of Radon through the Skin and Its Exhalation through the Lungs[1]

KURT LANGE, M.D.,[2] and ROBLEY D. EVANS, Ph.D.[3]

THERE ARE numerous reports in the medical literature that the local application of ointments containing radon have therapeutic effects on deep-lying structures, such as joints, muscles, and blood vessels (1, 2, 3, 4). On the other hand, there is the well established physical fact that the alpha rays from radon and from its short-lived decay products, radium A and radium C[1], have a range, or penetration, of not more than 30 to 50 microns in tissue.

Because one of us (5) had observed lasting and deeply penetrating effects on the vascular structures of an area treated with ointments containing radon, it appeared interesting to follow the fate of the radon (a chemically inert gas) originally contained in the ointment, to determine to what extent it enters the tissues. If it could be shown that radon does enter the tissues, deep effects of radon ointment therapy would be understandable. Once present in the blood stream, this absorbed radon should be transported to the lungs, and a portion of it should then be exhaled in the expired air. Measurements of the radon concentration in samples of expired air, together with knowledge of the expiration rate, permit a direct evaluation of the minimum quantity of radon absorbed from ointment, and hence available for the alpha radiation of tissues at a distance of more than 50 microns from the site of application.[4] The breath sampling and radon measurements were made by standard technics (6).

The experiments were carried out on normal intact skin, as well as on the surface of large post-phlebitic leg ulcers, which, however, were very poorly vascularized as demonstrated by repeated fluorescein tests (7). The ointment in every instance contained 44.4 microcuries of radon per c.c. (49 microcuries per gm.) of lanolin. The thickness of the application varied between 2 and 3 mm. The areas were immediately covered with oil silk or a watch-glass and then sealed with several layers of adhesive.

In the first group of experiments, samples of the exhaled air were taken after 20 minutes, $2^2/_3$ hours, and $4^1/_2$ hours. At each sampling time a specimen of the room air was taken and analyzed for its content of radon. In the first experiment, on three patients, possible inhalation of radon from the ointment during the procedure of application was largely inhibited by having the windows of the large ward wide open and creating a draft away from the patient's mouth toward the foot end of the bed. Table I indicates that approximately 2.4 per cent of the radon applied was exhaled within the first $4^1/_2$ hours when the ointment was applied to the leg ulcer, while the amounts absorbed under the same circumstances from normal skin and exhaled were only 0.13 per cent and 0.08 per cent for the same period.

In the second experiment further precautions were taken to prevent inhalation of radon during the application of the dressings. During this period the patient breathed oxygen from a B.M.R. machine. Later a large fan constantly moved a stream of air from the head of each patient toward the foot end of the bed and a suction line was installed under the blanket to remove any radon which might have

[1] Accepted for publication in August 1946.
[2] New York Medical College Research Unit (Metropolitan Hospital).
[3] The Radioactivity Center of the Department of Physics of the Massachusetts Institute of Technology.
[4] The ointment used in these experiments was supplied by the Canadian Radium & Uranium Corporation, New York City (Dr. L. Tomarkin, Director of Clinical Research).

TABLE I: EXHALATION OF RADON BY PATIENT HAVING RADON OINTMENT APPLIED TO A POST-PHLEBITIC ULCER OF THE MESIAL ASPECT OF THE LOWER THIRD OF THE LEFT LEG, COMPARED WITH TWO CONTROL SUBJECTS WITH SIMILAR APPLICATIONS TO THE LEFT LEG

Date Name Diagnosis	Amount Applied (49 Microcuries per Gram)	Area Applied (Approx.)	Milli-microcuries of Radon* per Liter of of Air After Various Intervals		Microcuries Exhaled during $4^1/_2$ Hours' Application	Percentage Exhaled in $4^1/_2$ Hours
10/9/45 J. G. Post-phlebitic leg ulcer	8.0 gm. Oil silk adhesive dressing	25 sq. cm.	20 min..... 160 min..... 270 min.....	>3.0 11.5 4.59	>9.3	>2.4
10/9/45 E. V. Myxedema	8.0 gm. Oil silk adhesive dressing	25 sq. cm.	20 min..... 160 min..... 270 min.....	0.508 0.393 0.205	0.50	0.13
10/9/45 G. E. Arteriosclerosis	8.0 gm. Watch glass adhesive	25 sq. cm.	20 min..... 160 min..... 270 min.....	0.159 0.355 0.140	0.32	0.08
Room air near patient			20 min..... 160 min..... 270 min.....	0.017 0.0028 0.0015		

* All values corrected for decay from time of application of dressing.

TABLE II: EXHALATION OF RADON BY PATIENT J. G., FROM TABLE I, FOLLOWED OVER A LONGER PERIOD, COMPARED WITH NORMAL CONTROL. OINTMENT APPLIED TO CORRESPONDING AREAS.

Date Name Diagnosis	Amount Applied (49 Microcuries per Gram)	Area Applied (Approx.)	Milli-microcuries of Radon* per Liter of Air After Various Intervals		Microcuries Exhaled in First Four Hours	Microcuries Exhaled in 23 hours
11/20/45 J. G. Leg ulcer	7.4 gm. Oil silk adhesive dressing	25 sq. cm.	11 min..... 30 min..... 1 hr..... 4 hr..... 8 hr..... 12 hr..... 20 hr..... 23 hr.....	10.4 16.6 10.1 7.1 24.0 13.3 4.1 3.3	6.7 (1.8%)	36.0 (10.0%)
11/20/45 F. D. Normal	6.3 gm. Oil silk adhesive dressing	25 sq. cm.	11 min..... 30 min..... 1 hr..... 4 hr..... 8 hr..... 12 hr..... 20 hr..... 23 hr.....	2.5 1.0 1.3 3.7 6.8 5.7 1.5 5.0	1.2 (0.4%)	14.0 (4.5%)
11/20/45 Room air			11 min..... 30 min..... 12 hr..... 23 hr.....	0.0006 0.004 0.005 0.002		

* All values corrected for decay from time of application of dressing.

leaked from the dressings. The experiments on these two patients, as shown in Table II, were carried out for 23 hours, with frequent sampling during the entire time of exposure. In one patient the ointment was applied to the intact skin, while in the other the application was made to a leg ulcer. This time the patient with the ointment on the intact skin exhaled during the first four hours approximately 1.2 microcuries or 0.4 per cent of the amount applied, and during 23 hours 4.5 per cent. The patient with the leg ulcer exhaled during the first four hours approximately 6.7 microcuries or 1.8 per cent, of the amount applied, and during 23 hours 10 per cent. All calculations are based on the assumption that the subject exhaled 5 liters of air per minute. The content of radon in the room air during each experiment was found to be negligible (Tables I and II). It is seen that the radon con-

centration in the inhaled air was only about one thousandth of the concentration in the exhaled air of either patient.

It is instructive to note that in the absence of diffusion of radon in the ointment, or actual absorption of the lanolin by the tissues, only a small portion of the radon applied could be effective in irradiating the tissues. This is because the average range of the alpha rays from radon and its radioactive decay products is about 40 microns of ointment. Over an area of 25 sq. cm., a surface layer 40 microns thick has a volume of only 0.1 c.c., or about one per cent of the volume of ointment applied. Alpha rays from disintegrating atoms of radon or its products situated more than about 40 microns from the lower surface of the ointment would be completely absorbed within the ointment, and could not emerge to irradiate the tissues. In Table II the radon actually exhaled greatly exceeded the radon content of a 40 micron layer of ointment. Evidently a much larger fraction of the total amount of radon applied becomes useful in irradiating the tissues beneath the ointment, by virtue of the continuous absorption of radon (and probably some lanolin also) from the ointment. In the 23-hour test on patient J. G. the radon exhaled was equal to that originally contained in a layer of ointment about 330 microns thick. Hence the efficiency of the ointment in supplying radon and its alpha radiation to underlying tissues is quite high.

It can thus be stated that appreciable amounts of radon applied in ointments are absorbed through the intact skin, and still more through open wounds. The radon exhaled must therefore have been carried to the patients's lungs internally, as in circulating blood or lymph. Radiation effects on deep structures may thus be produced if the amount absorbed and transported by the blood stream is sufficient. Whether amounts sufficient to produce tissue changes of therapeutic value can be thus absorbed and transported has not been proved.

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The Evolution of Radiology in Latin-America[1]

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A YEAR OR TWO AGO, on the occasion of a dinner meeting in Chicago in honor of some visiting colleagues from Latin-America, your speaker was impelled to discuss extemporaneously some of the important contributions of Latin-America to the advancement of radiology. When I was informed of the honor bestowed upon me by our Program Committee, I decided to enlarge upon this discussion by attempting to narrate the evolution of radiology in some of the countries of Latin-America.

My special interest in this subject has been stimulated by visits of numerous radiologists from Latin-America to my work in Battle Creek, Michigan, and in Chicago, and by my own visits to Cuba and to Mexico, as well as by two tours of the principal coastal national universities of South America. Further help has been afforded by correspondence and by a search of available literature.

ARGENTINA

When Roentgen's discovery was made known to the world, Dr. Jaime R. Costa, Professor of Medical Physics in the University of Buenos Aires, already established in his Sala de Fisioterapia in the Hospital Nacional de Clínicas, was able at once to utilize the new discovery, although the principal activity of the Institute concerned electrotherapy. Such progress was made in utilizing the x-rays that one of the early papers by Prof. Costa, "La practica de los rayos X," published in *Anales del círculo médico Argentina* (**23:** 1, 1900) concerned their use in fractures and dislocations, localization of foreign bodies, detection of hepatic and renal calculi, aneurysms, determination of the position and size of the heart, height of pleural effusions, extent of pulmonary tuberculous lesions, size and mobility of the liver, and many other diagnostic uses.

Professor Costa's Sala de Fisioterapia later became the Instituto de Fisioterapia, and still later the present important Instituto de Radiología y Fisioterapia Alfredo Lanari, which is under the direction of the present Professor of Radiology, Dr. Eduardo L. Lanari.

A group of early workers in radiology included Alfredo Lanari, Humberto Carelli, and Carlos Heuser. Dr. Heuser in 1902 wrote an article entitled "Radiología" concerning which he said: "I designate this work with the title 'Radiología' because I believe it to be more appropriate and more restricted to the different branches of this phase of science: radioscopy, radiography, endoscopy and radiotherapy." This was probably the first work published in the Argentine on radiology as a specialty. Heuser did notable work on the abdominal organs, kidneys, and pelvic organs, and between the years 1902 and the time of his death in 1934, he published a hundred or more articles on roentgen diagnosis and therapy and reported on various new methods of employing contrast materials for radiography. His diagnostic interests seemed to be focused on gynecological contrast studies. He made the first use of lipiodol in the genital apparatus in the year 1924. The writer read for Dr. Heuser a paper on hysterosalpingography at the Third Pan-American Scientific Congress held in Lima in December 1924. Dr. Heuser made several visits to the United States and Europe, enjoying a very wide acquaintance among the radiologists of the world. He was awarded the gold medal of the Radiological Society of North America in 1931.

Dr. Alfredo Lanari was chief of Clinic for

[1] Read at the Second Inter-American Congress of Radiology, Havana, Cuba, Nov. 17–22, 1946.

Professor Costa from 1902 to 1904, gave the first series of lectures on medical radiology in 1905, and following the death of Prof. Costa in 1909 succeeded to the Chair of Physical Medicine. In 1918 he became the Vice Dean of the Faculty and in 1919 Dean of the Faculty of Medicine of Buenos Aires, which position he held until 1929, when he was named "Vocal of the Medical Council of Education." He was interested not only in radiology but performed an immensely efficient work in forwarding education in general. He died in 1930.

Dr. Humberto Carelli is another of the group of radiological pioneers, having begun his career under Professor Costa in 1901 to 1904. Later, when Dr. Alfredo Lanari became Professor of Medical Physics, Dr. Carelli became Chief of Clinic during the years 1909, 1910 and 1911. Since then he has dedicated himself to the constant practice of radiology, in the course of which he has written on many themes, among which stand out his contribution to the radiological exploration of the abdomen by pneumoperitoneum and his personal contribution to the radiological exploration of the kidney by means of perirenal injection, known under the name of *neumoriñón* or perirenal emphysema, a method of examination which he described in lectures before universities, congresses, medical societies, and medical services of prominent personalities in foreign lands.

Dr. Carelli has been an extraordinarily capable organizer, as is shown by his creation of the Municipal Institute of Radiology and Physiotherapy, which was planned by him and directed by him until the year 1937, at which time he retired from his laborious duties to his private professional practice.

Dr. Eduardo Lanari in 1930 succeeded his brother, Prof. Alfredo Lanari, as Titular Professor of Radiology and Physiotherapy in the Faculty of Medicine in Buenos Aires and Director of the Instituto Alfredo Lanari del Hospital de Clínicas. Dr. Eduardo Lanari has written on the exploration of the gallbladder, foreign bodies in the eye, diagnosis and treatment of vesical tumors and of thyrotoxicosis, and especially on kymography. His publications have been numerous.

Dr. José A. Saralegui, after graduating in 1912, spent three years in the principal radiological institutes and centers of Europe. Thirty years ago he was named Chief of Service of Radiology in the Rawson Hospital and later in the Hospital Rivadavia, where he has carried on his radiological career. In 1937 at the International Congress in Chicago, Dr. Saralegui received a medal for his work on cholangiography. From 1940 to 1943 he held the position of Director of the Municipal Institute of Radiology and Physiotherapy, Buenos Aires, where he developed a plan of organization and modernization of radiological activities, personally directing the section on cancer and tumors and their treatment by radiation. Dr. Saralegui has contributed much to the study of the gallbladder by cholecystography and cholangiography, and to various phases of deep therapy in the treatment of tumors, including tumors of bone.

The late Dr. Jose Gutiérrez was a prolific and serious worker connected with the Section of Radiotherapy in the Alfredo Lanari Institute in the School of Medicine of Buenos Aires.

The late Prof. Martín Miranda Gallino was also possessed of a great enthusiasm for radiology. His numerous publications on the subject included a book on the heart. His premature death deprived radiology of a promising scientist.

Dr. José P. Uslunghi is Professor of Radiology and Physiotherapy of the Faculty of Medicine of La Plata; Adjunct Professor of Radiology and Physiotherapy in the Faculty of Medicine of Buenos Aires, and connected with the Rawson Hospital.

Dr. José F. Merlo Gómez, one of the most distinguished radiologists of Buenos Aires, is President of the Argentine Radiological Society and was President of the First Inter-American Congress of Radiology. He has done consistent work on

encephalography and on other problems relating to the skull, and has also made notable contributions in connection with military medicine in his country.

One could mention a long list of other contributors to the progress of radiology in the Argentine. Among them should be specified Dr. Alberto M. Marque, Director of the Institute of Radiology and Physiotherapy in the Hospital de Niños since 1907, when it was created and organized under his charge. He did early work on radiotherapy and possesses a brilliant collection of radiographs of osseous malformations, deviations, tumors, cysts, fractures, tuberculous osseous lesions, syphilitic lesions, etc., in an old and abundant material of radiographic plates, numbering some 15,000, which is considered one of the most valuable and varied radiological archives in South America. Dr. José L. Molinari wrote much on the radiodiagnosis and treatment of diseases of the female pelvis and the breast. Many other distinguished men are on the program of this Congress. A listing of their contributions to roentgenology and roentgen therapy would constitute a veritable encyclopedia of radiology.

In Cordoba, Dr. David Caro and assistants have done notable work. Here we also have Dr. Mirizzi, who made special advances in the use of cholangiography in connection with surgery of the gallbladder. Dr. Guido Politzer urged *digrafia* for the registration of respiratory movements. Dr. S. Di Rienzo is another indefatigable radiologist whose important work has contributed greatly to the advance of our specialty.

Dr. Mario Vignoles of the University of the Litoral, Dr. Antonio Padin and Dr. Rodolfo Ivancich from the city of Rosario should be named in the roll of honor of Argentine radiologists.

Buenos Aires alone maintains three active cancer diagnostic and treatment centers. The Municipal Institute of Radiology is especially concerned with clinical and research problems in radiation therapy. The Cancer Institute is an important one under the direction of Prof. Angel Roffo, whose name has become known throughout the medical world for his contributions to the etiology and biology of neoplasms. This Institute has a number of large buildings, including hospital facilities, radiological departments, and research laboratories. There is also an important tumor clinic in the surgical division of the University of Buenos Aires.

The original Radiological Society of Argentina was organized in 1917 and included such prominent radiologists as Alfredo Lanari, Antonio DeNucci, José F. Merlo Gómez and José A Saralegui, Carlos Heuser, Carlos Niseggi, Santiago Torres Blanco, Otilio Destugue, Rafael Espindola, and Antonio Valdviesco. The Society was reorganized a few years ago and seems to be on a very substantial footing.

BRAZIL

In Brazil, as one of their leading radiologists has put it, the development of radiology has been dominated largely from outside the country. Early clinical radiologists were E. Xavier, A. Alvin, and Jorge Dodsworth. Xavier was Professor of Medical Physics at São Paulo, beginning his work in 1896. A. Alvin died as a result of irradiation injury.

In the second generation, Duque Estrada, Saint Pastous, Raphael de Barros, and Manoel de Abreu, all living, made their radiological débuts between 1910 and 1920. Their roles have been marvelous. Since that date the number has multiplied and radiology now exercises a decisive influence in the evolution of scientific medicine.

In 1912 a powerful x-ray equipment was established in the city of Pará by Magalhães and Silva Rosado. In 1916 at Belém, Até was well established in radiology. In 1917 Dr. Jayme Rosado, who had studied under Dr. Campelo and Dr. Duque Estrada, was becoming well known.

The use of x-rays in São Paulo began less than a year after the publication of Roentgen's discovery. In 1896 Professor

Ferreira Ramos of the Polytechnic School operated a small Crookes' tube with a Ruhmkorff coil, obtaining the first radiograph made in São Paulo. Early in 1897, Dr. Alfredo Britto made a demonstration of x-rays in the Faculty of Medicine.

Medical radiology began in São Paulo with the work of Henrique Carlos Gruschke. In 1899, under the supervision of Prof. Vieira de Carvalho, the first x-ray department was opened at the Santa Casa de Misericordia. Studies were made at that time, not only of traumatic lesions of the skeleton but also of the cardiovascular and renal apparatus. The first roentgenogram of a twin pregnancy was obtained in 1906. Prof. Vieira de Carvalho died of a grave anemia following a severe radiodermatitis, after submitting to various amputations of the fingers, another Brazilian martyr to the x-rays. In 1906 methods of protection began to appear, including leaded aprons and lead glasses. Madame Gruschke followed her husband as director of the radiological services in the Santa Casa de Misericordia, continuing also his teaching work.

Another outstanding medical radiologist in São Paulo was Prof. Dr. Edmundo Xavier. Other pioneers were W. Seng, D. Stapler, and A. C. Camargo. In 1913, coincident with the appearance of the first Coolidge tubes, there began to work in São Paulo Dr. Raphael de Barros, Dr. Priori, and Dr. Nagib Scaff.

The advance of radiology in foreign lands was observed with interest by radiologists in São Paulo, and the various German, English, American, and French radiological publications all aided in keeping radiology in São Paulo up-to-date. The advent of serial radiography, stereoradiography, planigraphy, and kymography, with various contrast materials, and the methods of Graham-Cole, Lichtenberg, and others, were all adopted promptly.

Today a large number of up-to-date radiologists are at work in this great city, and not only in radiography but also in radiotherapy most important progress has been made. Their publications and communications before scientific societies have made them known. Particular mention should be made of the work of Cassio Villaca and Paulo de Toledo on the digestive apparatus; Eduardo Cotria on heart measurements, renal pathology, and gynecology; Cabelo Campos on hepato-vesicular pathology; and the work of Raphael de Barros on osseous pathology.

Radiotherapy began with the work of Lindenberg in 1911, who as a dermatologist took up superficial roentgen therapy. In the field of therapy other outstanding names are L. Barretto and Roxo Nobre.

In the field of technic, the house of Lohner has constructed special apparatus for the measurement of the cardiac area by the method of Eduardo Cotria. Mention should be made, also, of the construction of apparatus for cineradiography, according to the method of José Jany and Dr. Moretsohn de Castro and their associates.

A special method of cineradiography has been developed and publicized from São Paulo. Many efforts at roentgen cineradiography have been made. Prof. H. Rieder, of Munich, was one of the pioneers in Europe. In the United States Dr. L. G. Cole in 1910 and later Dr. Wm. H. Stewart, of New York, did notable work, though many others could be mentioned. Ing. José Jany and his colleagues, notably Dr. Moretsohn de Castro, devised a method of cineradiography utilizing a a pre-hypersensitized film for photographically recording the fluoroscopic screen image. Jany contributed not only the idea and technic of hypersensitization but also the construction of accessory equipment which may be adapted to any radiological table by modifying the screen support. Jany's work is applicable not only to the chest and to the extremities but also to the gastro-intestinal tract.

The work of Manoel de Abreu in Rio de Janeiro deserves special mention. His pioneer work in photoroentgenography has led to the development of the present 4 by 5-inch technic perfected by Dr. Hollis E. Potter. Dr. Abreu also did much in the

development of radiology of the vascular pedicle in the thorax. Among his former assistants was Dr. Aguinaldo Lins.

The National Department of Public Health of Brazil has a national cancer service in Rio de Janeiro, and there is in prospect a cancer institute. Other Brazilian cities have joined the cancer campaign, particularly Rio Grande do Sul, São Paulo, and Bahia. In Recife there is an Institute of Radiotherapy established in 1941 under the direction of Dr. Waldemir Miranda. São Paulo is planning to open a cancer institute. Recife, São Paulo and Medellin all have radiological institutes.

CHILE

Zegers is credited with having introduced the x-rays into Chile in 1897. Another early radiographer was a Mr. Eckwall, a Swedish graduate in gymnastics and massage, who worked as x-ray technician in the Hospital San Juan de Diós until he succumbed to numerous epitheliomatous lesions of the hands in the year 1915.

The first physician to incorporate x-rays in his diagnostic methods was the Professor of Physics in the School of Medicine, Dr. José María Anrique, who had just returned from a study tour of Europe. Dr. Anrique was chief of the service of radiology of the Hospital Clínico, and to him was due the organization of radiology in the different hospitals of the Beneficencia, which services he directed for many years until 1916. In that year he succeeded to the chair of Physical Medicine, and the direction of the radiological services was assumed by Dr. José Ducci, a man of vast culture, whom members of the Chilean radiological group recognize as one of its most brilliant investigators. Ducci was a man of exceptional talent, improvising whatever apparatus he lacked. It seemed that there were for him no impossible problems. He developed stereoscopic fluoroscopy and serial radiography with apparatus of his own manufacture. Unfortunately a renal infection interrupted his magnificent work in radiological physics. The Institute of Radiology of the Faculty of Medicine in the Hospital Clínico de San Vincente de Paul in Santiago was re-named in his honor, the José Ducci Institute of Radiology.

Ducci had the foresight to establish a a sort of school of radiology where every day there were gathered together radiologists, pathologists and clinicians and their assistants for discussion of interesting clinical cases.

Among the radiologists who continued the work of Ducci were Drs. Quevedo, Meza Olva, and Adolfo Kaplan, who had assisted the chief of the laboratory for seven years. Kaplan has made several long study trips to the United States. A later group of radiologists included Drs. Opazo, Daza, Gundelach, Dighero, Riedel, Viviani, Zárate, E. Soza Gostling, L. Guzmán, and many others. Dr. Leonardo Guzmán is at present Director of the Institute of Radiology in Santiago, a most important clinical center and headquarters for the Chilean League Against Cancer.

COLOMBIA

An x-ray equipment was installed in Bogotá, Colombia, early in this century by Dr. Isaac Rodríguez. Shortly afterwards Dr. Germán Reyes also brought a diagnostic roentgen apparatus to Bogotá. At an early date Prof. Julio Manrique set up x-ray equipment in Barranquilla. The late Dr. José M. Montoya has also been mentioned as an early user of Roentgen's discovery. It was not, however, until 1920 that radiology was seriously practised as a specialty in Colombia. At that time the Bogotá School of Medicine engaged the services of the French radiologist, Dr. André J. Richard, then working in the United States.

Very early there came about a tendency to divide the field of radiology into roentgen diagnosis and roentgen therapy. Dr. Richard brought about the creation of a chair of roentgen diagnosis, which in 1934 provided for radiological instruction for last year medical students in the National University of Colombia.

Dr. Alfonso Esguerra Gómez, who dis-

covered the "pâte Colombia" or Colombian paste while working in the Radium Institute of Paris in 1922, was responsible for the creation in 1938 of the National Institute of Radium, devoted to radium and roentgen therapy. This Institute, connected with the Faculty of Medicine, up to 1944 has been equipped with six deep therapy installations and 2.5 grams of radium. The Institute is dedicated to research and education and maintains a course in cancerology for graduate students. The first director was Dr. José V. Huertas, who was recently replaced by Prof. César A. Pantoja.

Roentgen diagnosis in Colombia owes much to our distinguished colleague, Dr. Gonzalo Esguerra Gómez, who has carried out extensive investigations and has written profusely on radiology of the gallbladder, on urography, the gastro-intestinal tract, and especially amebiasis. In well organized classes in the medical school, he and other members of the teaching personnel of the radiological staff have arranged and conducted roentgen instruction for undergraduate as well as postgraduate students.

Other Colombians whose works in the field of x-rays have come to our notice may be mentioned: Dr. Eduardo Ricaurte Medina, who made interesting observations on urography, certain bone lesions such as melorrheostosis, secondary pulmonary tumors, pneumopericardium, and metastases from mammary cancer; Dr. Francisco Convers, who has engaged in both roentgen therapeutics and diagnosis; Dr. Carlos Trujillo Venegas and Dr. Jorge Rosas Cordovez, for their publications on diaphragmatic hernia and duodenal uncinariasis; Dr. Julio Medina on aortography and arteriography; Dr. Omar Benavides on photofluororoentgenography; Dr. Emilio Acosta on leprosy in Colombia; Dr. Alejandro Isaza Botero on osteomyelitis in children of Bogotá; Dr. Milciades Mogollón Fernández on pelvimetry and anthropometry; Dr. Carlos Fajardo on the radiologic diagnosis of brain tumors. Of special interest in Colombia has been the subject of rhinoscleroma, upon which Dr. Ricardo Calvo wrote nearly twenty-five years ago. Other publications were by Dr. Alfonso Esguerra Gómez and Dr. Daniel Brigard.

Another pioneer in medical radiology was Dr. Aguinaldo Soto, who, after practising internal medicine for several years, took up the specialty of radiology in Paris, where he spent more than ten years. For several years he was Professor of Radiotherapy and Electrotherapy in the Faculty of Medicine of the University of Bogotá. Dr. Enrique Otero became well known as radiologist of the Hospital de San José de Bogotá and of the Hospital Militar.

The Colombian Radiological Society has recently been organized with twenty-two members, mostly from Bogotá, but with representatives, also, from Medellín, Cali, Barranquilla, and Armenia.

CUBA

In this the host republic of our Congress, the first physician seriously to dedicate himself to radiology was Dr. Alfredo Domínguez Roldán, first president of the Sociedad Cubana de Radiología y Fisioterapia. He is recognized by his colleagues as the "father" of radiology in Cuba and founder of several of the important radiological departments in the hospitals of Havana, where, under his supervision many of the now prominent Cuban radiologists began their work. He published a book on the thorax. In 1911 he was the official delegate from Cuba to the Second Congress of Radiología y Electrología Médica in Barcelona, a report of which he made in a publication of two hundred and forty-six pages.

More or less contemporary with Domínguez were Dr. Emilio Alamilla and Dr. Carlos Desvernine. Alamilla did much to establish radiology as a specialty in Cuba. He was named Professor of Physics in the Instituto de la Habana in 1899, a position he held until his death in 1924 while on a visit to the United States. He was the first to establish deep therapy equipment in Cuba. Desvernine was especially devoted to the study of pulmonary tuber-

culosis, placing emphasis on fluoroscopic guidance in diagnosis and treatment.

Filiberto Rivero was another active member of the executive committee of the original Cuban Radiological Society. He was a strong advocate of cooperation between the clinician, the surgeon, and the radiologist as a means of bringing to completion a joint work of the greatest benefit to the patient and to the study of human pathology. He contributed largely to the development of radiology as a specialty.

Francisco Cabrera Benitez published in 1913 a book on "Radiodiagnóstico y Fisioterapia de la Tuberculosis."

Other early leaders in Cuban radiology were Manuel Viamonte, whose best known contributions from 1927 to date include discussions of the radiological diagnosis and treatment of pulmonary abscesses, fibrinous pneumonia, cardiac insufficiency, lesions of the colon, including inflammatory and amebic tumors, and many other subjects. At the present time he is Professor of Radiology of the University of Havana and Director of the Department of Radiology in the Calixto García Hospital.

Dr. Raúl Pereiras, in collaboration with Dr. Castellanos and others, has made many important contributions to radiopaque angiocardiography, superior and inferior cavography, retrograde aortography, and anterior pneumomediastinum.

For original contributions of the greatest importance we are indebted to our honored colleague, Dr. Pedro L. Fariñas, who began his work in radiology in 1912. Special interest attaches to his intensive investigations and publications on serial selective bronchography. In these cases, instead of making roentgenograms after opacification of the bronchial tree, serial exposures are made during the most interesting and important phases of the filling of the bronchi. This permits the discovery of images, not otherwise visible, of very early lesions of bronchial cancer and other tumors, and especially of cases of incomplete bronchial stenosis. Dr. Fariñas also recommends the replacement of iodized oils in bronchography by organic salt solutions of iodine to avoid the inconvenience of lipiodol. Lately he has improved the technic by an original method of covering the mucosa of these organs with a very thin layer of opaque substance, accomplished by vaporizing an opaque medium in the vestibule of the larynx. Inhalation of this vapor causes production of very fine particles which are deposited along the mucosa of the larynx, trachea, and bronchi. Dr. Fariñas has also contributed notably to retrograde abdominal aortography and phlebography.

ECUADOR

Pioneers in radiology in Ecuador were Dr. Pablo Arturo Suarez and Dr. Juan Verdesoto. These men were Professors of the Faculty of Medicine of Quito and of Guayaquil, respectively. Among the younger men who are at present active in radiology are Terán Gostalle, present Professor of Radiology in Quito, and Dr. Julio Mata Martínez, Professor of Radiology in Guayaquil.

MEXICO

In 1899 some demonstrations of x-rays were made to the students of physics in the University of Mexico City. The first physicians to utilize x-rays in medical practice, as far as I can learn, were Dr. Joffre (1900) and Dr. Cícero, the latter being also an early advocate of x-rays in dermatology, recording the successful treatment of a case of ringworm of the scalp in 1911. The first pulmonary roentgenograms in Mexico were made by Dr. Joffre in 1902, these studies being published by my friend Dr. Alfonso Pruneda in an inaugural thesis concerning the symptoms and diagnosis of early pulmonary tuberculosis.

The Military Hospital was provided with x-ray apparatus as early as 1905. In that year Drs. Zubieta and Pérez de la Vega and in 1910 Drs. Peter and Somonte made various contributions on therapy and roentgen diagnosis. Dr. Manuel F. Madrazo, also one of this group of pioneers, is well known in the United States, through personal visits and by writings on various

topics related to orthopedic roentgenology as well as on roentgen kymography. Dr. Celis has presented works on angiocardiography by catheterization of the jugular vein. Recently Dr. Carlos Gómez del Campo has explored the aorta by direct puncture of the arch, but this work is still experimental. Dr. Perez Cosío has written on cholecystography.

Dr. Larios and Dr. Cornelio in Guanajuato were early workers in radiology, the latter dying in consequence of x-ray injuries.

The campaign against cancer in Mexico has made excellent progess. The General Hospital of Mexico City has a new Cancer Institute. An annual cancer congress is held in Guadalajara. Monterrey has an Institute of Radiology established in 1936.

The Radiological Society in Mexico has recently been organized, some of the charter members being Dr. Dionisio Pérez Cosío, Dr. Guillermo Rodríguez Garza; Dr. Manuel F. Madrazo; Dr. Carlos Coquí; Dr. Jose Ramírez Ulloa; Dr. J. Arribas Aveleyra; Dr. Juan José Quezada; Dr. Carlos Gómez del Campo.

PERU

The first x-ray apparatus was brought to Peru and the first radiograph was made by Dr. Constantino T. Carvallo, Professor of Gynecology in the Faculty of Medicine of Lima, who with European apparatus obtained a film of the hand one night in October 1896. According to Dr. C. E. Paz Soldán, President of the Sociedad Peruana de Historia de la Medicina, that night there were obtained roentgenograms of the hand of the President of the Republic of Peru.

The Hospital of Santa Ana for women was the first hospital to be provided with an x-ray installation, in about 1904, and there chiefly radioscopy was practised. This department was directed by Dr. I. Avendaño and later by Dr. E. Olivares.

A more complete x-ray equipment, with which regular roentgenographic work was done, functioned later in the Hospital Dos de Mayo for men, under the charge of Dr. J. L. Becerra, the dean of living radiologists in Peru, who is still director of that service. In 1922 the out-dated German radiological installation in the Hospital Dos de Mayo was replaced by modern American equipment through the philanthropy of Mr. A. Aspillaga, who about three years later provided the new hospital for women, Arzobispo Loayza, with a complete roentgen diagnostic and roentgen therapeutic equipment, including apparatus for treatment at 200 kilovolts, directed by Dr. Oscar Soto, with the collaboration of Dr. S. Sánchez Checa, Dr. H. Pesce, and Dr. E. González Vera.

Official instruction in radiology in the Faculty of Medicine of Lima was carried on from 1923, the first professor being the late Dr. Estéban Campodónico. Since 1935 the professor of radiology has been Dr. Oscar Soto.

In 1938 the Peruvian Society of Radiology was organized. Its presidents, from its foundation until today, have been the following radiologists: Dr. Oscar Soto, Dr. S. Sánchez Checa, and Dr. E. González Vera.

Among the Peruvian hospitals provided with radiological installations should be especially mentioned the Hospital Obrero, with five apparatus for diagnosis and two for therapy; The Instituto Nacional de Radioterapia where there are four installations for radiotherapy to which two more are being added; the Hospital Arzobispo Loayza with three radiodiagnostic installations and two for therapy, and the Hospital Dos de Mayo with two equipments for diagnosis.

A prominent Peruvian physician who started out in radiology but became so enamored of flying that he devoted himself to aviation is Dr. Armando Revoredo, now a General in the Aviation Section of the Peruvian Army.

Dr. Fortunato Quesada has done much to advance radiology. We are indebted to him for a simple but very effective technic for radiography of the clavicle, whereby two films are obtained in such a way as to record two projections, one at an angle of

90° to the other. He has recently emphasized the value of cholecystography.

URUGUAY

The first radiograph in Uruguay was made in the early months of 1897. There had been received in the customs house at Montevideo, addressed to the president of the republic, a box of suspicious character sent from Buenos Aires. At that time there functioned in Buenos Aires the directorate of the Nationalistic Party which had declared civil war against President Borda, who was later assassinated, on Aug. 25, 1897. This box, which actually contained x-ray equipment, was immediately seized by the police, since there was a strong suspicion that it might be an infernal machine likely to explode on being opened. An expert from the department of physics of the University, Professor Scoseria, was instructed by the court to examine the box. Considering the form in which the box had been prepared for shipment, the exterior aspect indicating a very solid and careful construction, and considering, above all, that a paste with the odor of phosphorus had been found on raising one of the cleats covering the screws fixing the lid of the box, the fear was increased that it might be explosive. Professor Scoseria considered the matter sufficiently suspicious to justify an examination made with every possible precaution. It was a little more than a year and a half after Roentgen had published his discovery of the new kind of rays, that Girard and Bordet of the Municipal Laboratories of Paris had indicated the possibility of applying the roentgen rays to discover the presence of metallic substances in infernal machines. So, with the apparatus already existing in the Laboratory of Physics at the University, and with the assistance of Professor Williman, Professor Scoseria examined the box with the x-rays and determined the true nature of its contents. The full description and photographs of the apparatus, together with the means of examination, were published in *La Razón* of June 22, 1897.

Carlos Butler was the first Professor of Radiology and Director of the Institute of Radiology in the Faculty of Medicine of Uruguay. In 1939 he was named also Director of the Institute of Radiology and of the Center for the Campaign Against Cancer carried on by the Ministry of Public Health. In 1943, Drs. García Capurro, Frangella, and Caubarrere were named as assistant professors.

In the following year Professor Butler retired from the direction of the Institute of Radiology and the Chair of the Faculty of Medicine, being succeeded by Dr. Pedro Barcía as Professor and Director of the Institute of Radiology, and Dr. Frangella in his turn was named sub-director of this same Institute. But Dr. Butler continued with the direction of the Institute and Center for the Campaign Against Cancer carried on by the Ministry of Public Health until Nov. 8, 1943, the date of his death. Dr. Felix Leborgne was named director in his place.

It should be noted that under the stimulus of Professor Butler and of Professor Barcía, radiology in Uruguay has reached a degree of advancement worthy of great commendation. Let us note briefly the fine work of Butler in the organization of the battle against malignant diseases and his publications on the subject; the numerous writings of Pedro Barcía on various themes, especially the digestive tube; a book on cancer of the larynx, the magnificent work of Felix Leborgne; the writings of Raúl Leborgne dealing with the breast; various books and articles of García Capurro on the thorax and abdomen; a book and articles by Frangella on therapy; contributions by Caubarrere, and various others. These Uruguayan contributions constitute an eloquent testimony and a bright promise of what may be expected in the future from the radiologists of that republic.

VENEZUELA

The earliest reference to x-rays in Venezuela appears to be an article by Dr. Elías Toro in 1897. About ten years later Dr. Luis Felipe Blanco described the value of

the x-ray in determining the size of the stomach. Another ten years elapsed before there began to appear literature on roentgen diagnosis.

In 1917 Dr. Rafael Gonzáles Rincones and his brother, Dr. Pedro González Rincones, began a series of contributions which over the course of many years have proved numerous, both in the field of x-ray diagnosis and therapy and in that of radium therapy. Their earlier contributions concerned the digestive tube, but they later reported on cholecystography, stereofluororadiography, and mass photofluorography, as well as excretion urography. All the advances of radiology which have been made were promptly taken up by the Drs. González and adapted to their work in Venezuela. In addition, Dr. Pedro González Rincones brought out a new technic for simultaneous radiographic exploration of the mastoids bilaterally.

Other contributors to the advance of roentgen diagnosis have been A. J. Castillo and P. A. Gutiérrez Alfaro, who have written on pyelography and roentgenography of the mastoid. Otto van Steis and A. M. Aguado wrote on the gallbladder. M. Galland and H. de las Casas wrote on lumbosacral diagnosis; A. Puigvert on urography in 1930. Enrique Márquez Iragorry in 1931 described the first hysterosalpingography done in Venezuela, further described by E. P. de Bellard in 1933. R. L. Araujo in 1934, Adolfo D'Empaire in 1934, and P. A. Gutiérrez Alfaro in 1941 all made further contributions. Manuel Noriega Trigo in 1936 and Carlos Ottolina in 1938 have written on ventriculography. Tomography was described in 1938 by Dr. Pedro González Rincones, who in 1931 also reported on excretion urography. E. P. de Bellard in 1933, A. Alvarenga in 1938, A. Borjas in 1939, L. E. López in 1941 and finally Pedro González Rincones in 1944, all have studied and reported on excretion urography.

Roentgen therapy has been a favorite subject of radiologists in Venezuela, beginning with P. Aguerrevere in 1907; E. Ruis Viso in 1917; Rafael González Rincones, Dr. Luciani, and Emilio Conde Flores in 1923; Victor M. Lozada in 1931, and numerous others.

The Luis Razetti Cancer Institute has been in operation for a number of years.

The purpose of this communication has been to assure our colleagues of Latin-America that we of the North feel a great interest in the radiological activities of our co-workers, and salute them for the great work which they have done. No doubt numerous omissions and some errors will have crept into this account, and for these forgiveness is asked.

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EDITORIAL

Anatomical Variations in the Female Pelvis: The Caldwell-Moloy Classification

Since 1933, when Caldwell and Moloy (1) first came out with their classification of the female pelvis, several articles have been written by the same authors and their co-workers on the general use of x-ray in the study of the mechanics of obstetrics, particularly as it relates to pelvic form and fetal-pelvic relationships. Other writers have added to the literature follow-up reports to evaluate further the application of these studies by careful clinical-roentgenologic correlation. It has been rather definitely shown that measurements are not the entire story and that the x-ray can be of aid in determining the course of labor over and above the procedures which deal primarily with the mensuration of the fetal head and maternal pelvis. The problem is not entirely one of size, but includes pelvic form and fetal-pelvic relationships. If one disregards the clinical correlation, particularly with border-line disproportions, one will easily mislead the clinician and discredit an otherwise valuable roentgen procedure, however important fetal cephalometry and maternal pelvimetry may seem to be in a specific case.

. A recent article by Nicholson and Allen (2) we believe deserves some comment. These authors criticize the Caldwell-Moloy classification of the female pelvis because of its lack of precision. They feel that there are so many subclassifications under the four parent types that the method of classification becomes unwieldy. To quote these authors: "Classification may be a fine weapon in the armament of science, but classification without precise definition is simply the negation of science and can only lead to the multiplication of types until every example has a type of its own." They seek to disprove (1) the fact that the android pelvis is a male pelvis and that it is associated with other male stigmata in the female, (2) that the android pelvis and to some extent the anthropoid pelvis are associated with narrow outlets, and (3) that the android pelvis is associated with difficult labor, propositions which they say Caldwell and Moloy have propounded. They attempt to produce proof that the android pelvis is associated with neither contraction of the pubic angle nor with difficult labor. They also point out that any deformities in the pelvis which lead to difficult labor are due to deficient nutrition in childhood.

Some of these ideas cannot go unchallenged. In the first place, Caldwell and Moloy never "argued" that the android pelvis was necessarily associated with difficult labor. They did say that a relatively small android pelvis is more apt to cause trouble than a relatively small gynecoid pelvis because of the difficult mechanism that may be associated with the android type. In those pelves which are borderline or normal as to size, the pelvic form may play a major role. In this regard Nicholson and Allen have missed a very important point. They have apparently misunderstood the literature in regard to the Caldwell-Moloy classification and its clinical application. It is obvious that a large android pelvis does not necessarily mean difficult labor. Furthermore, a careful review of the writings of Caldwell and Moloy and their co-workers will disclose the fact that these authors are very emphatic in pointing out that the subpubic arch does not necessarily reflect the pelvic type. It may be more common to find a

narrowed subpubic angle in an android type but this does not necessarily hold true.

Nicholson and Allen further would like to eliminate any hereditary or hormonal factors as a cause for a pelvis which produces difficult labor. All pelvic deformities they attribute to deficient nutrition in childhood. It is difficult, indeed, to see how deficient nutrition would produce the long oval type of pelvis, namely the extreme anthropoid type. No one will deny that nutrition has an effect, but probably only in so far as it affects the general size of an already predetermined pelvic type. Whereas Caldwell and Moloy have wished to emphasize the shape rather than the size, their critics apparently wish to reverse this and go back to the old idea that size alone counts.

It is difficult to understand the complaint of Nicholson and Allen about the intricacy of classification. Their four types correspond to the four parent types of Caldwell and Moloy. If they wish to stick to these without using subtypes, I am sure Caldwell and Moloy would have no complaint. Any classification that attempts to be too complete may admittedly become unwieldy.

The deductions of Nicholson and Allen may, however, have the danger of discrediting an important contribution to our obstetric and roentgenologic knowledge and literature. We thus think caution is to be advised in interpreting their conclusions. There is little question that Caldwell and Moloy have made a most valuable contribution by their classification. They have done much to help us apply roentgen-ray study to the female pelvis and have made it possible for the radiologist to aid his obstetrical confrere in a manner which has been of epoch-making significance. Before the detailed work of these authorities, the roentgen study of the female pelvis was a relatively uninteresting and certainly not easily applicable procedure. Caldwell and Moloy succeeded in popularizing the use of the x-ray in obstetrics and took it out of the mere field of mensuration. They have used a dynamic approach which has provoked many favorable comments from leaders in both the obstetric and radiologic fields. If Nicholson and Allen wish to stick to the four original types as described by Sir William Turner and use their pelvic index in talking about pelvic shape, that is their privilege, providing they obtain the same results as others. We still think, however, that Americans will be unafraid to use the Caldwell-Moloy classification even though our British confreres imply that it carries the threat of being too scientific.

PAUL C. SWENSON, M.D.

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AMERICAN COLLEGE OF RADIOLOGY EXPANDS PUBLIC RELATIONS PROGRAM

For some six years the Committee on Publicity of the Radiological Society of North America has availed itself of the assistance of the Commission on Public Relations of the American College of Radiology in publicizing the annual scientific sessions. A large amount of favorable publicity, educating the general public concerning radiology, has thus appeared in the nation's press.

A generous grant of funds from the X-Ray Section of the National Electrical Manufacturers Association to the American College of Radiology has enabled the Commission on Public Relations to expand its work this year. The press relations program is no longer confined to the annual meetings of the two scientific societies but is sustained throughout the year. The editors of RADIOLOGY and of the *American Journal of Roentgenology* send advance page proof of each issue to the College office, and from the papers appearing in these, one or more news stories are prepared and distributed to members of the National Association of Science Writers, wire services, state and county medical journals, and health publications.

This expanded activity of the College should be of real value in bringing about a better understanding of the specialty of radiology. Our thanks are due our good friends in the manufacturing industry who compose the X-Ray Section of the National Electrical Manufacturers Association for their generosity.

UNIVERSITY OF CALIFORNIA COURSE ON APPLICATION OF NUCLEAR PHYSICS TO BIOLOGICAL AND MEDICAL SCIENCES

The University of California Medical School, in association with University Extension, University of California, announces a Course in the Application of Nuclear Physics to the Biological and Medical Sciences. This course will be given at the Medical Center, in San Francisco, from June 30 through July 18, 1947. It will consist of didactic lectures, laboratory demonstrations, and seminars for round table discussions, and will be open to individuals in the fields of medical and biological research. Requests for detailed information are to be addressed to Stacy R. Mettier, M.D., Head of Postgraduate Instruction, Medical Extension, University of California Medical Center, San Francisco 22, Calif.

LOUISVILLE RADIOLOGICAL SOCIETY

The Louisville Radiological Society held its first post-war meeting on March 20, 1947, at which time it was decided to hold future meetings on the second Friday of each month at the Louisville General Hospital. Dr. Sydney E. Johnson was elected Chairman of the Society and Dr. Everett L. Pirkey, Secretary-Treasurer.

AMERICAN CONGRESS OF PHYSICAL MEDICINE

The American Congress of Physical Medicine will hold its twenty-fifth annual scientific and clinical session Sept. 2–6, inclusive, at the Hotel Radisson, Minneapolis. In addition to the scientific sessions, the annual instruction courses will be held Sept. 2–5. Requests for further information should be addressed to American Congress of Physical Medicine, 30 North Michigan Ave., Chicago 2, Ill.

In Memoriam

ROBERT E. DOWNING, M.D.

Dr. Robert E. Downing died on Oct. 5, 1946, at the age of forty-one. He was graduated from Emory University in 1930 and received his training in radiology at Long Island College Hospital. For several years he was in private practice in Terre Haute, Indiana, where in 1936 he married Miss Mildred Pinnell, a registered x-ray technician. He went to Lexington, Kentucky, as a radiologist at the Good Samaritan Hospital in 1938. Dr. Downing was a captain in the Medical Reserve Corps, and was called to active duty in July 1941, with an assignment at Bowman Field, Kentucky. He contracted an acute respiratory infection in August 1943, which was followed by cardiac complications. After long hospitalization, he returned to Lexington and part-time civilian practice at the Good Samaritan Hospital in 1944. He died following an attack of coronary thrombosis during a vacation at his father's home in Brewton, Alabama. He is survived by his wife and a four-year-old daughter.

Dr. Downing was a diplomate of the American Board of Radiology and a member of the Radiological Society of North America. His professional skill and interest in the problems of his associates and their patients gained him the respect of all with whom he came in contact in his work. A friendly smile and a delightful sense of humor had won "Bob" the genuine affection of all who knew him. That his professional career should be so soon brought to a close is a source of deep regret.

D. B. HARDING, M.D.

JAMES MURRAY FLYNN, M.D.

James Murray Flynn died in St. Mary's Hospital, Rochester, N.Y., on Dec. 14, 1946, after a short illness. Dr. Flynn was born in Rochester, March 29,

James Murray Flynn, M.D.

1882. He was graduated from the University of Buffalo Medical School in 1914 and did postgraduate work at Leland Stanford University. Almost all of his medical work was as a specialist in radiology. He served in France with Base Hospital 19 during World War I and received the rank of Captain. At the time of his death he was roentgenologist for St. Mary's Hospital and Park Avenue Hospital in Rochester.

Dr. Flynn had been president of the Medical Society of the County of Monroe, the Rochester Academy of Medicine, and Rochester Pathological Society. He was president of the Medical Society of the State of New York in 1940. He was a fellow of the American College of Physicians, a fellow of the American College of Radiology, a diplomate of the American Board of Radiology, and a member of the Radiological Society of North America, of the American Roentgen Ray Society, and the American Radium Society. He belonged also to the Royal Faculty of Radiologists of England.

As noted in the Bulletin of the Medical Society of the County of Monroe: "In his passing, organized medicine loses a staunch worker, loyal friend and distinguished leader. He was a stalwart champion of the rights of the medical profession, jealous of its honor and exemplified its duties and responsibilities in his own daily conduct." It could be said of him in the truest sense: "I have fought a good fight, I have kept the faith." He will be greatly missed by his friends and associates.

Dr. Flynn is survived by his wife, a son, and four daughters.

JOSEPH H. GREEN, M.D.

LEONARD ALBERT MYERS, M.D.

On Nov. 29, 1946, death from coronary occlusion came to Dr. Leonard Albert Myers of Houston, Texas, director of the X-ray Department of Memorial Hospital for the past sixteen years, and until six years ago also head of the pathology laboratory of that institution.

Doctor Myers was born in Cloud County, Kansas, in 1896. His boyhood was spent in Oklahoma and he was graduated from the University of Oklahoma Medical School in 1922. He served his internship

Leonard Albert Myers, M.D.

at Memorial Hospital, Houston, Texas, and later went to Alexandria, Louisiana, where he was director of radiology and pathology for the Baptist Hospital of that city, serving at the same time as consultant radiologist and pathologist at the United States Veteran's Hospital No. 27. He returned to Houston in 1930.

Doctor Myers did postgraduate work at various northern and eastern clinics, among which were Barnes Hospital of St. Louis and the Mayo Clinic. He served in the Naval Reserve for seven years. He was a member of the American Medical Association, Texas State Medical Society, Southern Medical Association, Radiological Society of North America, and the Texas Radiological Society. During his stay at Memorial Hospital he was president of the Hospital Staff in 1942, and served on many important committees.

Dr. Myers had an unusually wide circle of friends in Houston and surrounding cities as well as in

Louisiana and Oklahoma. He had a ranch in Oklahoma, and next to his profession he enjoyed the country, for he was a natural fisherman and hunter. In fact, he loved life and made the most of every minute, living fully and abundantly. He was known for his honesty and integrity and had built an enviable reputation both as a radiologist and pathologist. He has left an example of good faith, good judgment, good teaching, and good fellowship. He reflected only credit and honor on the practice of medicine and of his specialty.

His wife, two sons, and a daughter survive him.

JULIA STEELE ELEY, M.D.

LOUIS M. PIATT, M.D.

Dr. Louis M. Piatt, of Columbus, Ohio, was killed March 2, 1947, in an automobile accident while returning from a vacation in Mexico.

Doctor Piatt was born in 1899. He was graduated from Ohio State University in 1923 and served his internship at St. Rita's Hospital, Lima, Ohio. Following this, he was engaged in general practice for sixteen years in Ottawa, Ohio. In 1940 he left Ottawa to become affiliated with the New York Post-Graduate Medical School and Hospital. While there he served as resident radiologist for two years. In 1943 he became associated with Dr. Edward Reinert, of Columbus, Ohio, in the practice of radiology. He was also associated with Grant, St. Francis, and Mercy Hospitals. He was particularly interested in the treatment of cancer.

Doctor Piatt was a member of the Radiological Society of North America, the American College of Radiology, and the American Medical Association. Not only will he be missed by his professional associates, but his thoughtfulness and kindness will be long remembered by all who came in contact with him. He is survived by his wife, a daughter, a son, and by his brother, Dr. Arnold D. Piatt.

Book Reviews

X-RAY DIFFRACTION STUDIES IN BIOLOGY AND MEDICINE. By MONA SPIEGEL-ADOLF, M.D., Professor of Colloid Chemistry and Head of the Department of Colloid Chemistry, and GEORGE C. HENNY, M.D., Professor of Medical Physics and Head of the Department of Physics, Temple University School of Medicine, Philadelphia. A volume of 215 pages, with 86 illustrations. Published by Grune and Stratton, Inc., New York, 1947. Price $5.50.

With courage in the face of several books by authorities on x-ray diffraction and with skill in the face of a difficult subject combining physics, chemistry, biology, and medicine, two distinguished scientists have brought together in this book widely scattered material of great usefulness particularly to research biologists. There has been an urgent need for such a book, in a sense recognizing a new branch of biology and medicine. Here is first-hand evidence of the thinking and self-training and research of two medical school professors who have recognized, as pioneers, the value of diffraction technics in the study of materials produced by life processes. They have studied the literature intensively, envisioned their own research problems, designed and built on a limited budget their own apparatus, interpreted their own diffraction patterns to the best of their ability, and correlated the results with the findings from other clinical, chemical, and instrumental methods.

In order, the chapters present the theory of x-ray diffraction, apparatus and technics, interpretation, and studies on carbohydrates, amino acids and derivatives, proteins, nucleic acids and nucleoproteins, muscle lipids, nerves, steroids, and bones, teeth and concretions. The theory, apparatus and technics, and interpretations are presented as simply and briefly as possible. There is an air of quiet unpretentiousness about these chapters which seem to reflect the honesty of the authors in that they are not trying to compete with writers whose life-long specialization has been x-ray diffraction. Actually there is enough of the fundamental description of the tool and its use to permit adequate understanding of the results in chapters in which the authors stand on more familiar ground. There is throughout a kind of faith and undercurrent of enthusiasm for the x-ray field which strike a most sympathetic note within the reviewer in contemplation of his own quarter century of missionary zeal. There is also an unusually thorough and appreciative treatment of prior work in the attempt to give credit to everyone to whom it may be justly due; and akin to this is the modest appraisal of the valuable contributions of these authors themselves. One can forgive many shortcomings when a book is written in this spirit.

One might wish to find something about what space groups are (a few are given for specific cases in the old instead of the beautifully logical new international symbols); or reciprocal lattices, a concept so valuable for fiber and rotation patterns, and mentioned a time or two; or commercially available equipment, along with the details of a successful homemade unit; or a mention of the A.S.T.M. card index of powder patterns, which have superseded and gone far beyond the original Hanawalt-Dow tables. Of course, these things can all be found in more extended treatises, to which anyone undertaking research by this method would be expected to refer.

Well might these authors have undertaken to do this service with some fear and trembling at first; courage, devotion, and the true research spirit have seen them through successfully. The volume is worthy of a place in the reading of all scientists who have even a remote interest in the possibilities and the achievements of a branch of roentgen science entirely different from the more familiar diagnostic and therapeutic applications.

The book is well printed on glossy paper and attractively bound. The x-ray patterns, many of which are most difficult to reproduce, show the care and high standards of the authors. Of the whole work, we may say "Well done!" Stimulation of research on the architecture of living materials is an inevitable consequence of this book.

APPLIED ANATOMY OF THE HEAD AND NECK FOR STUDENTS AND PRACTITIONERS OF DENTISTRY. HARRY H. SHAPIRO, D.M.D., Assistant Professor of Anatomy, College of Physicians and Surgeons, Columbia University. A volume of 303 pages, with 221 illustrations. Published by J. B. Lippincott Co., Philadelphia, 2nd edition, 1947.

This small but well written, well illustrated book of 290 pages is designed specifically for students and practitioners of dentistry. As such, it not only takes up the anatomy of the head and neck, but also correlates the anatomy of these regions with many clinical problems. In this respect the book is unique.

The chapter on the temporomandibular joint is particularly impressive, since it very successfully relates the basic anatomy of this area to the complex clinical problems that arise therefrom. From a radiological standpoint, however, the book does not appear to offer anything beyond what has previously been published in basic texts on this subject.

HARVEY CUSHING: A BIOGRAPHY. By JOHN F. FULTON. A volume of 754 pages, with numerous illustrations. Published by Charles C Thomas, Springfield, Illinois, 1946. Price $5.00.

Foreseeing the demand for some account of his life and achievements, Harvey Cushing made provision in his will for the publication of a biography, should his wife and literary executor feel that this "might be of interest or help to medical students." Fortunately not only for the students whom Cushing had in mind but for all who are interested in medicine—and indeed many others—there was no question as to the desirability of such an undertaking. The result is this volume recounting the life of one of the foremost trail blazers and men of letters who have graced the medical profession during the past century.

Harvey Cushing was a product of the mid west, with a long line of medical progenitors of whom he was justly proud. He was educated at Yale and at Harvard, and then went to Johns Hopkins, where he was associated with Halsted and almost immediately fell under the spell of Osler and Welch, who profoundly influenced his life. One can trace Cushing's development in the field of letters from the time he became one of the "latch-keyers" of the Osler household, culminating in his celebrated biography of Osler, for which he was awarded the Pulitzer prize in 1926.

After a thorough training in general surgery, Cushing devoted himself especially to surgery of the central nervous system and by intensive study and meticulous attention to detail achieved the position which made him world-famous. He was largely instrumental in establishing neurosurgery as an independent specialty and trained an ever-increasing number of men who have added further to his prestige. Roentgenologists will be interested to know that he set up the first x-ray unit in the Johns Hopkins Hospital and was always deeply interested in x-ray diagnosis and therapy.

Cushing's fullest development came after his appointment as Surgeon-in-Chief to the Peter Bent Brigham Hospital and as Moseley Professor of Surgery at Harvard University, where he spent twenty fruitful years. His last years were passed at Yale, and to that University his rich collection of medical-historical books was bequeathed.

Dr. John F. Fulton, Sterling Professor of Physiology at Yale and Dr. Cushing's literary executor, has performed a notable task in the preparation of this biography, making effective use of the voluminous source materials available to him—diaries, letters, case histories, and other papers, which had been carefully preserved over the years. Abundant quotations from these personal records, enlivened with reproductions of Cushing's own inimitable sketches and with a large number of informal portraits of the surgeon and his professional contemporaries both in America and Europe, give the work almost the character of an autobiography. Mr. Charles C Thomas, who was Cushing's own publisher, has done his part in making this work a fitting memorial to his friend. To all who are interested in medical history in the making and in biography at its best, the book will prove richly rewarding.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to cooperate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates. Address: Howard P. Doub, M.D., The Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Harold Dabney Kerr, M.D., Iowa City, Iowa.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John Day Peake, M.D., Mobile Infirmary, Mobile. Next meeting at the time and place of the Alabama State Medical Association meeting.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, D. R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5.

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION. *Secretary*, Moris Horwitz, M.D., 2009 Wilshire Blvd., Los Angeles 5. Meets second Wednesday of each month at County Society Bldg.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Ivan J. Miller, M.D., 2000 Van Ness Ave. Meets monthly on the third Thursday at 7:45 P.M., January to June at Lane Hall, Stanford University Hospital, and July to December at Toland Hall, University of California Hospital.

Colorado

DENVER RADIOLOGICAL CLUB. *Secretary*, Washington C. Huyler, M.D., Mercy Hospital, 1619 Milwaukee, Denver 6. Meets third Friday of each month, at the Colorado School of Medicine and Hospitals.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Robert M. Lowman, M.D., Grace-New Haven Hospital, Grace Unit, New Haven. Meetings bimonthly, second Thursday.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maxey Dell, Jr., M.D., 333 West Main St., S. Gainesville.

Georgia

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, T. J. Wachowski, M.D., 310 Ellis Ave., Wheaton. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2. Meets second Friday of each month at Louisville General Hospital.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2. Regular meetings in the Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. A. Neely, M.D., 924 Sharp Building, Lincoln. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary-Treasurer*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, W. H. Seward, M.D., Orange Memorial Hospital, Orange. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway, L. I.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Abraham H. Levy, M.D., 1354 Carroll St., Bklyn. 13. Meets fourth Tuesday of every month, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary-Treasurer*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings in January, May, and October.

LONG ISLAND RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Wm. Snow, M.D., 941 Park Ave., New York, 28.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary*, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary-Treasurer*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 1338 Second St., N., Fargo.

Ohio

OHIO RADIOLOGICAL SOCIETY. *Secretary*, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Hugh A. Baldwin, M.D., 347 E. State St., Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George L. Sackett, M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists). *Secretary-Treasurer*, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meets third Tuesday of each month.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Peter M. Russo, M.D., 230 Osler Building, Oklahoma City. Meetings three times a year.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Lester M. J. Freedman, M.D., 415 Highland Bldg., Pittsburgh 6. Meets second Wednesday of each month at 6:30 P.M., October to May, inclusive.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. M. Popma, M.D., 220 N. First St., Boise, Idaho.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. Lowry Allen, M.D., Judge Bldg., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE. *Secretary*, Henry H. Lerner, M.D. Meets first and third Thursdays, September to June, inclusive, at Salt Lake County General Hospital.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, E. Latan Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Frederic E. Templeton, M.D., 324 Cobb Bldg., Seattle 1. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day meeting in May and one day at annual meeting of State Medical Society in September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D., 2100 Marlowe Ave., Montreal 28, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets on third Saturday of each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Congenital Anomaly and Fracture of the Atlas. J. W. Wilson and N. M. Brown. Canad. M. A. J. **55:** 52–53, July 1946.

Two cases are briefly reported—a congenital defect in the posterior arch of the atlas, discovered following an accident, and a fracture of the atlas. A short discussion of Jefferson's work (Brit. M. J. **2:** 153, 1927) is presented, in which an attempt was made to dispel the belief that fractures of the atlas carry a high mortality rate and that they are very rare. Hinchey and Bickel (Ann. Surg. **121:** 826, 1945. Abst. in Radiology **46:** 422, 1946) are also quoted as having found an over-all mortality rate of 10.7 per cent in a collected series of 112 fractures of the atlas. PHILIP W. DORSEY, M.D.

Early Diagnosis in Tumours of the Central Nervous System. W. Lister Reid. M. J. Australia **1:** 865–872, June 22, 1946.

The author has sought in this paper to present in abbreviated form the more important points to be considered in the early diagnosis of intracranial and intraspinal expanding lesions. Among the significant features is the progressive nature of the symptoms and signs. These are taken up individually and a detailed outline for neurologic examination is included. Under the heading "Subjective Symptoms" are considered headache, epileptiform seizures, vomiting, ataxia, vertigo, dysphagia, and mental symptoms. As to the last, the author is emphatic, cautioning against the error of attributing these to a psychoneurosis without definitely ruling out an intracranial expanding lesion, or misinterpreting tumor symptoms engrafted on a previous hysteria. "Objective findings" to be sought for include septic foci, extracranial new growths, changes in blood pressure (chiefly from the standpoint of differential diagnosis), and cranial nerve and motor disturbances.

Roentgen examination is considered under the heading "Special Methods of Investigation," along with spinal, cisternal and ventricular puncture, biopsy, and manometric tests. The x-ray findings receive adequate comment—the things we usually look for and seldom find, as changes in the vascular channels (of doubtful significance, in the abstractor's opinion), erosion, hyperostosis, pineal shift, etc. Ventricular air studies furnish the most valuable information with regard to the presence and localization of intracranial lesions. The author deserves hearty commendation for striking sharply at the use of thorotrast, which, he says, may produce ependymitis, when injected into the ventricles, as well as an inflammatory reaction in the subarachnoid space, sometimes extending along the sheaths of the optic nerves. The chief field for this medium is arteriography, but for demonstration of neoplasms the author prefers air studies as safer and of greater diagnostic efficiency. Lipiodol has been of value in localizing intraspinal lesions but has the disadvantage of being nonabsorbable.

The following conclusions are reached: "It is doubtful if it will ever be possible to carry out a successful removal of malignant neoplasms involving the basal ganglia, mid-brain, pons, or medulla. Also it is very questionable if it is justifiable to remove cerebral metastatic tumours or rapidly growing gliomata. Excellent results, however, are obtained with the less malignant gliomata and with non-malignant tumours, provided that they have not progressed to the state at which essential cerebral or spinal function is interfered with . . . Every patient with symptoms referable to the central nervous system which become progressively worse should be regarded as a tumour suspect until proved otherwise, and should be subjected to a complete neurological investigation, including examination of the cerebro-spinal fluid and ventricular air studies."

PERCY J. DELANO, M.D.

Craniopharyngiomas in Children. Franc D. Ingraham and H. William Scott, Jr. J. Pediat. **29:** 95–116, July 1946.

Sixteen children with craniopharyngiomas were treated by the surgical services of the Children's Hospital and the Peter Bent Brigham Hospital from 1932 to 1945 inclusive. Two of the cases are presented in detail. The embryologic and pathologic aspects of the tumors are discussed.

In general, the presenting symptomatology of craniopharyngiomas in the 16 children at the time of initial hospitalization was characterized by intracranial hypertension as manifested by headache and vomiting (15 cases) associated with progressive loss of vision (9), arrested skeletal development (5) and, uncommonly, with diabetes insipidus and the overt forms of hypothalamic disorders. Changes in the optic disks were present in all 16 patients. Visual field determinations could be carried out in 13. Essentially normal fields were found in 5 instances; 5 patients had bitemporal hemianopsia or bitemporal quadrantic defects; 1 showed a right homonymous hemianopsia, and 2 had lost all vision in the field of one eye and had temporal defects in the other eye field. Ten children were essentially normal in size, development, and physical appearance. Blood and urine studies at the time of hospitalization were not unusual except for low specific gravity of the urine in 3 patients with diabetes insipidus.

Roentgenograms of the skull showed definite abnormalities in all of the patients. Calcification above the sella turcica was present in 8 cases, and intrasellar calcification in 2 others. This finding is almost pathognomonic of the tumor in children. The visible calcification is most often present in the solid, basal portion of the tumor, appearing in the roentgenogram as a collection of delicate, spongy opaque flecks. Rarely, there may be large masses of calcium and, still more rarely, part of the cyst wall may be outlined by calcification. Roentgen evidence of increased intracranial pressure, as indicated by separated sutures, convolutional atrophy, or erosion of the clinoid processes was observed in 7 children. The sella turcica was enlarged and distorted in one-half the cases. Usually, the enlargement of the fossa is of an irregular type, with depression of the floor, and is associated with erosion of the dorsum sellae or posterior clinoid processes.

With a history of failing vision, headaches, and vomiting, and the roentgen finding of calcification in or above the sella turcica, a diagnosis of craniopharyngioma can usually be made unequivocally in children. Although dermoid cysts, chordomas, and teratomas may occur

in the vicinity of the sella, they are much less common and are not likely to show the delicate flecks of calcification so characteristic of craniopharyngioma. In 10 of the patients in this series no diagnostic difficulties were encountered.

All of the 16 patients with craniopharyngiomas were treated by surgical exposure of the cyst by transfrontal craniotomy with aspiration of contents and removal of as much of the cyst wall as was readily available in each instance. Five of the children are now alive, a survival rate of 31 per cent. Only 2 of these can be considered "cures" from the standpoint of significant survival. One boy, although retarded in growth, has normal vision and has lived for thirteen years without evidence of recurrence since the partial removal of the cyst. The other patient, also a boy, is totally blind but has had no return of symptoms for ten years.

The authors' experience with irradiation in these cases is too limited to warrant any conclusions, but on the basis of that of Davidoff and others, they feel that a critical appraisal should be made of roentgen therapy, as an adjunct to surgery, for these tumors.

Method of Ventricular Fluid Replacement Following Ventriculography. Arthur A. Morris. J. Neurosurg. 3:351–354, July 1946.

A method of replacing ventricular fluid following ventriculography is described. This procedure is often desirable in hydrocephalus of congenital origin, especially in cases due to a periaqueductal stenosis.

Odontoma of the Nasopharynx. George McClure. Arch. Otolaryng. **44:** 51–60, July 1946.

The author reports what he believes is the first case of odontoma of the nasopharynx to be recorded. A firm growth was discovered in the pharynx at the time of tonsillectomy, when the patient was seven years of age. For three years no appreciable increase in size of the mass was noticed. At twelve years of age, the patient complained of difficulty in hearing, frequent sore throats, and her speech was somewhat thickened. Left lateral roentgenograms of the neck showed a tooth, apparently a molar, in the left posterior area of the pharynx. It did not appear attached to any bone. There was slightly increased density around it, probably due to remnants of the tooth bud. A diagnosis of non-malignant embryonic bony tumor was made, and the mass was excised. Pathologic examination showed a benign osteofibroma (dentigerous origin—tooth in malposition). Seven years later the growth had returned. Stereoscopic left lateral and submentovertex views of the skull revealed a dense shadow resembling a dental structure in the posterior wall of the pharynx, on the left side, in the region of the orifice of the eustachian tube. Surrounding this shadow was a larger shadow of lesser density which appeared to be calcification with a cyst wall. It was thought that a dermoid cyst was lying in the posterior wall of the nasopharynx. The recurring tumor with the deciduous tooth was removed. The recurrence of the growth and the formation of a second deciduous tooth definitely put the tumor in the classification of compound composite odontoma.

Chronic Phosphorus Poisoning. H. Heimann. J. Indust. Hyg. & Toxicol. **28:** 142–150, July 1946.

Three cases of chronic yellow-phosphorus poisoning are presented. In each instance, a jaw was involved. The first patient complained of rheumatic pain, and several teeth were extracted, with no relief of the joint pains and aggravation of the jaw pain. A diagnosis of osteomyelitis of the lower jaw was made and the relationship of the patient's condition to his occupation went unrecognized for some time. In the other two cases the diagnosis was made earlier and therapy instituted promptly. In one instance the upper jaw was involved, and it was found that such a case responds poorly to any type of therapy. Preventive measures are outlined. Roentgenograms are reproduced in 2 cases.

THE CHEST

The Lateral Decubitus Position in X-Ray Examination of the Chest. Samuel Richman. J. Mt. Sinai Hosp. **13:** 83–85, July-August 1946.

The lateral decubitus position in x-ray examination of the chest is of particular value for the following purposes and under the following conditions:

(1) To demonstrate a fluid level in the chest in patients who are too weak to assume an upright position. The left decubitus position may also be used to determine the presence of free air under the diaphragm in cases of suspected perforated peptic ulcer, etc.

(2) To differentiate the character of effusion in the pleural cavity.

(3) In females where the breast tissue frequently obscures the lower lung fields, especially the costophrenic sinuses. Comparison of a film taken in lateral decubitus with one in the usual upright position, showing the persistence or non-persistence of shadows, may be of considerable aid in differential diagnosis.

(4) In the presence of fluid in the pleural cavity. The position and appearance of the diaphragm can be more easily made out than in the upright film.

(5) In patients in whom the fluid in the pleural cavity presents an atypical appearance in the upright position.

(6) To reveal in greater detail the pathologic change in the lateral peripheral (axillary) portion of the lung. Due to the crossing of the ribs in this region, fine lung detail is difficult to distinguish. In the lateral decubitus position the shift of the mediastinum and the lung tends to bring into view more of the lateral peripheral lung area, thus enabling one to see more clearly any change occurring there.

It is suggested that the lateral decubitus position be used more frequently, especially in cases of suspected disease in the region of the diaphragm and costophrenic sinus. Illustrative roentgenograms are reproduced.

A Light, Compact X-Ray Generator of High Efficiency for Mass Radiography of the Chest. Russell H. Morgan and Emmet G. Murphy. Pub. Health Rep. **61:** 982–989, July 5, 1946.

The authors describe and set forth the advantages of a small light-weight x-ray generator capable of operation from 110-volt domestic power lines. There is increasing need for a unit of this sort in mass radiography of the chest. It is a constant-potential generator making use of two condensers in the circuit. The article demonstrates graphically the greater brightness obtained from the photofluorographic screen when the x-ray tube potential is constant. The tube-screen distance is reduced to 30 inches, thus limiting exposure times and decreasing the quantity of heat generated within the x-ray tube. As a result of the above factor, the generator may be operated as quickly as photofluoro-

graphic schedules can be maintained without overheating the tube. The complete unit weighs approximately 600 pounds. It supplies a distinct need in the field of photofluorography in mass surveys. M. IVKER, M.D.

An Evaluation of a Chest X-Ray Resurvey of an Industrial Plant. Morton Kramer, George W. Comstock, and Joseph B. Stocklen. Pub. Health Rep. **61:** 990–1001, July 5, 1946.

The purpose of this paper is to report the results of two mass chest x-ray surveys done with an interval of 18 months in a large industrial concern in Cleveland, Ohio. On the first survey (November 1943), photofluorograph equipment was adapted to the purpose and did not include a phototimer. Perforated 35-mm. film was used. The subjects were required to strip to the waist and don paper jackets. For the second survey (May 1945), equipment designed for survey procedures was used with a Morgan-Hodges phototimer and Fairchild 70-mm. camera. This time the employees remained clothed. The medical officers and other survey personnel were entirely different for the two surveys. The physicians reading the miniature films did not know that their interpretations were to be used for comparative study. The films in both surveys were read more hurriedly than is the usual practice. This was particularly true in the second project because of illness in the survey team. In the first survey 6,287 persons were examined; in the second, 5,679.

The tuberculosis prevalence rate was 1.3 per cent in the first survey and 1.4 per cent in the second, both figures being slightly lower than the similarly determined rate of 1.6 per cent in 102,000 mass x-ray examinations among the industrial population of Cuyahoga county (in which Cleveland is situated).

By comparing x-rays of persons diagnosed as tuberculous on the 1945 survey with these taken in 1943, it was found that of 97 cases that should have been detected in 1943, 20 or 20.6 per cent were missed. Similarly by checking the films of persons diagnosed as tuberculous in 1943 against those of 1945, it was found that of 88 persons who should have been diagnosed as tuberculous in the 1945 survey, 10 or 11.4 per cent were missed.

Important factors in the erroneous diagnoses of 1943 are believed to be the eyestrain and fatigue involved in reading 35-mm. films with the viewing equipment then available and the lack of phototiming.

In only 5, or 0.13 per cent of the 3,981 non-tuberculous individuals in the 1943 survey did reinfection tuberculosis develop in the following eighteen months. Such a low incidence would indicate that a resurvey at an interval of eighteen months of persons previously known to be non-tuberculous is of little value as a case-finding procedure. These findings indicate that once the tuberculosis status of the employees of a plant has been determined by a mass survey, it would be of value to require preplacement examinations of all persons subsequently employed, thereby affording earlier diagnosis for new employees with tuberculosis and more adequate protection to other persons in the plant.

BERT H. MALONE, M.D.

Miniature Photofluorography of the Clothed Subject. Ira Lewis. Pub. Health Rep. **61:** 1002–1004, July 5, 1946.

The practical advantages in time saved, confusion avoided, and efficiency gained from the examination of clothed subjects in mass x-ray procedures are obvious, provided, of course, that such practice produces results of a quality equal to that realized by the conventional examination of the unclothed subject. Radiologists of the Tuberculosis Control Division, United States Public Health Service, have interpreted, in the course of their duty throughout the country, tens of thousands of miniature films of clothed subjects. Their experience permits the persistent belief that clothing causes no diagnostic errors through obscuration, though no controlled tests to demonstrate the analogous qualities of products of the two procedures is known to have been made.

In view of these considerations, the author examined a considerable number of persons both with and without clothing, reaching the following conclusions. There is no objection to clothed persons in chest survey programs. Speed of operation is increased; less dressing-room space and personnel are required. This method, moreover, will appeal to women and will attract greater numbers of persons to photofluorographic installations with a resultant accelerated action toward the objective of mass surveys (the x-raying of every adult in the United States). Because of these many new examinees and because thousands of new cases of tuberculosis will be brought to medical attention, the x-raying of clothed subjects, even if conducive to a narrow margin of error, would be the procedure of choice. Furthermore, it is reasonable to assume that factors other than clothing, such as technical faults and subjective error inherent in some interpretations, might well introduce greater diagnostic deviation. HUGH A. O'NEILL, M.D.

Results of Mass Radiography of R.A.F. Ex-Prisoners of War from Germany. A. G. Evans. Brit. M. J. **1:** 914–915, June 15, 1946.

On their return to Great Britain from German prison camps, 9,142 Air Force personnel were subjected to mass radiography. Forty-seven of the number were found to have active and 64 inactive tuberculosis; 59 had calcified nodules; 27 calcified hilar lymph nodes, and 51 calcified nodules and lymph nodes. In 57 per cent of the active cases the sputum was positive for tuberculosis. On questioning, it was found that the food had been adequate until the last six months. As most of the men had been interned for one to four years, it would appear that the high incidence of infection may be associated with close living quarters and a lowered resistance—in the first instance due to mental stress and later to actual malnutrition.

Non-tuberculous conditions revealed by the survey included: bronchitis, emphysema, bronchiectasis, pulmonary fibrosis, congenital abnormalities, acquired cardiovascular lesions, pleural thickening, aberrant pneumonic consolidation, and shrapnel in the chest wall and lung fields. HENRY K. TAYLOR, M.D.

Apical Tuberculosis. Roentgenological Technique for Its Early Recognition with Some Pathogenetic Applications. Abraham J. Flaxman. Am. Rev. Tuberc. **54:** 1–8, July 1946.

Fibrotic tuberculous lesions in the pulmonary apices are found frequently at autopsy, their incidence being considerably higher than is demonstrated by conventional chest roentgenography. Because these fibrous "scars" may contain caseous areas with viable bacilli, they may, under certain conditions, undergo reanima-

tion with further progression of the disease; thus the term "latent apical tuberculosis" is applied to them.

In order to visualize the apices to best advantage, the author uses the posterior lordotic position. The roentgen tube is centered to the cassette and then is tilted upward 5° from the horizontal and lowered about 4 inches until the central ray again is centered to the cassette. The patient stands with his back to the cassette, hands on hips, shoulders against the cassette holder, feet about one foot forward, knees slightly bent, and the abdomen protruding in a position of lordosis.

Reproductions of roentgenograms are included to show the value of the method in delineating small apical lesions. L. W. PAUL, M.D.

Results and Experiences in Twenty-Five Cases of Phrenic Crushing with Pneumoperitoneum in Exudative Tuberculous Pleurisy. R. Rosenfeld. Schweiz. med. Wchnschr. **76:** 551–554, June 22, 1946.

The author treated 25 patients with tuberculous pleural effusion by first crushing the phrenic nerve and then inducing a pneumoperitoneum. Eighteen of these cases were primary; the other 7 were recurrences. In 7 cases the disease was bilateral. One patient, suspected of having a neoplasm, was made worse; in 5 cases there was no benefit; in 15 the results were good to excellent, and there were 4 apparent cures. Patients showed immediate benefit with fall of temperature following the operation.

The treatment should be continued over a four-month period for best results, although in occasional cases this time may be shortened to two months if necessary. The principal complication is mediastinal emphysema, and deaths have been reported in the literature as a result of this accident. In the present series, mediastinal emphysema was observed only once, and the patient recovered. As a measure to control the incidence of this accident the author recommends that only 800 to 1,000 c.c. of air be introduced at a sitting. In left-sided disease the gastrocardiac symptom complex with pain in the shoulder may be observed following each filling. While this is not serious, it may be controlled by not exceeding 600 c.c. of air per filling.

The author believes that, while the method is not as yet an established one, it holds great promise in this type of disease. LEWIS G. JACOBS, M.D.

Pneumonitis Occurring in Rheumatic Fever. George C. Griffith, A. W. Phillips, and Curtis Asher. Am. J. M. Sc. **212:** 22–30, July 1946.

Pneumonitis occurring in the course of rheumatic fever is characterized by an inflammatory process in the lung and pleura, with insidious onset, migrating consolidation, and frequently pleurisy, with or without effusion. This complication was found in 119 of a group of 1,046 rheumatic fever patients, most often in association with the acute and polycyclic types of the disease.

Gross examination shows areas of mottling which are characteristic of infarctions. These areas may be found in all lobes of the lungs. This histologic picture is that of an anaphylactic angiitis involving the larger as well as the capillary vessels. Aschoff bodies may be found freely in various stages of development and maturity. In this series, effusion occurred in 10.9 per cent of the cases. The effusions, which tend to be temporary, are sterile, and straw-colored to sanguineous in appearance. At times, they contain large numbers of eosinophils. The effusion may absorb very rapidly with little residual evidence of pleurisy.

Primary acute pneumonitis may be, at times, the presenting manifestation of rheumatic fever. On physical examination, an area of dullness, which may develop into frank consolidation, may be found in one or more lobes. More frequently, the area clears after a few days and another area develops. After two or three days other manifestations, such as migrating polyarthritis, carditis, and a sustained relatively high temperature, appear. The course is severe and prolonged. It is the opinion of the authors that where there is primary right heart failure in rheumatic fever, pneumonitis is one of the initiating causes. Of the cases of acute fulminating rheumatic fever, 53.1 per cent had rheumatic pneumonitis, and in about one-half of these, the initial symptoms were referable to the lungs.

Secondary acute pneumonitis occurs during the course of established rheumatic fever, most often in the polycyclic type. It is usually one of the presenting symptoms of the second or third cycle.

Subclinical pneumonitis is found accidentally, since there are no symptoms and few, if any, signs. The diagnosis is based entirely on the roentgenographic findings.

The characteristic roentgen-ray findings in rheumatic pneumonitis and pleuritis are the rapid onset and clearing of the densities found at the sites of the clinical findings, and the sudden reappearance elsewhere in the lung fields. A pleural effusion may also appear and disappear rapidly. Multiple, and upper, lobe involvement occurred more frequently in the very ill patients. Effusion occurred in about 18 per cent of the cases with demonstrable pleurisy, but the incidence was much higher if pleural pain is taken as the diagnostic criterion.

The primary acute pneumonitis cannot be distinguished from primary atypical pneumonia, either clinically, by sputum studies, by roentgen ray, or by blood studies. It is only recognized when other manifestations of rheumatic fever appear. The signs which are most helpful in establishing the diagnosis are carditis, migrating polyarthritis, purpura, erythema marginatum, epistaxis, and subcutaneous nodules. An onset of pneumonia with a chill is not found in rheumatic pneumonitis. In congestive failure, the air hunger and the increased venous pressures are more marked, and there is an enlarged, pulsating tender liver. The laboratory aids are of little help in the differential diagnosis except in lobar pneumonia.

BENJAMIN COPLEMAN, M.D.

Tomography in the Diagnosis of Lung Carcinoma. J. Blair Hartley. Proc. Roy. Soc. Med. **39:** 531–534, July 1946.

Tomography has been used in the diagnosis of pulmonary carcinoma in the Holt Radium Institute (Manchester, England) in part because of objections to the use of lipiodol on the part of the therapists, in part because of the limitations of bronchoscopy, and more specifically because of the desirability of ascertaining the exact depth of the lesion, so that, if roentgen therapy is desired, it can be directed to the proper level.

The technic employed is described by the author as rather primitive, the simple attachment used being merely a lever between the tube and the cassette tray. The length of the tube shift is between 12 and 15 inches, while the film shift is between 2 and 3 3/4 inches. The

exposure is given as constant 100 ma. for an average of two seconds. A lead diaphragm is used rather than a cone. To depict the bronchi, tomograms are obtained at intervals of 1 cm., the usual levels being at 9, 10, 11, and 12 cm. from the table top.

The author assesses the value of tomography under seven headings: (1) It confirms or rules out bronchial obstruction previously diagnosed. (2) It may demonstrate the size and/or depth of a carcinoma already diagnosed and reveal the true nature of lesions undiagnosed or inaccurately diagnosed. (3) It may reveal whether a carcinoma is of ulcerating or obstructing type, and whether the lesion is extensive and of the peribronchial infiltrating type. (4) It may bring out details not evident in the plain film. (5) It may reveal compression or displacement of air passages. (6) It may aid in follow-up examination, determining whether changes in the chest picture are the result of recurrence or incident to treatment. (7) The immediate and late results of radiation therapy are best discerned in this way.

As to the limitations of the procedure, the author states that it does not necessarily indicate the exact nature of the lesion, even though the definite point of obstruction can be outlined; it is frequently unreliable in determining how much of a lesion may be attributed to neoplasm and how much to inflammation; small lesions of the lungs, trachea, and main bronchi are easily missed; and, finally, interpretation is at best difficult.

It is concluded that, while tomography cannot replace routine radiography of the chest, it should replace lipiodol bronchography where the case is likely to be one of carcinoma of the bronchus and where radiation therapy is indicated. SYDNEY F. THOMAS, M.D.

Sarcoidosis (Besnier-Boeck-Schaumann's Disease). Report of a Case in a Child Simulating Still's Disease. Agustin Castellanos and Enrique Galan. Am. J. Dis. Child. **71:** 513–529, May 1946.

A detailed report is made of a bizarre case recorded as the first instance of sarcoidosis observed at the Children's Hospital of Habana.

The patient, a 6-year-old white Cuban boy, was admitted to the hospital having fever, polyarthritis, a symmetric erythematomacular eruption on the face and arms, generalized adenopathy, dry cough despite the presence of râles in both lungs, splenomegaly, mild uveitis, and pin-point non-vesicular keratitis. The illness had an insidious onset three years before admission and had been gradually progressive.

Roentgen studies showed miliary mottling in both lung fields suggesting tuberculosis, but gavage sputum cultures failed to reveal acid-fast bacilli and negative reactions were obtained to tuberculin tests up to 1:100 dilution. Some thickening of the mucosa was noted in both antra. Soft-tissue swelling was evident about the large joints of all the extremities, being especially marked about the knee joints. No remarkable findings were present in the bones, including the phalanges.

Aspiration of the knee joints revealed a pus-like material that proved to be sterile on culture. Biopsy of the synovial membranes showed non-specific chronic inflammation. Tissue section of the left deltoid showed 6 to 10 nodules in the subcutaneous and muscle layers having the microscopic features of sarcoid granulomas. Cytodiagnostic puncture of the lung and aspiration of sternal marrow yielded numerous histiocytes and multinucleated cells. Those found in the bone marrow were similar to the giant cells seen in Boeck's sarcoid.

A provisional diagnosis of Still's disease was made at first, based on the history of a gradual onset and prolonged fever, and on the findings of chronic polyarthritis deformans and splenomegaly. After further evaluation of the pulmonary findings, the eye lesions, the dermatitis, and the deltoid biopsy, the diagnosis was changed to sarcoidosis. The patient was discharged with some general improvement.

Four months later, the patient was readmitted because of dyspnea, remittent fever, and great weight loss. Roentgenograms now showed a right pleurisy with effusion, and, after artificial pneumothorax, consolidation in the right lower lobe. The tuberculin test, in 1:1000 dilution, gave a strongly positive reaction and an atypical Arthus phenomenon developed. Culture and inoculation examinations of the pleural effusion, joint exudate, and sputum still yielded no tubercle bacilli or any pyogenic bacteria. Biopsy of an inguinal node showed microscopic evidence of sarcoid.

The miliary pulmonary lesions noted on the first admission and the protean systemic findings described above were considered as manifestations of sarcoidosis. The process present in the right lower lobe on the second admission was diagnosed as a complicating tuberculous lobitis.

A note appended to this report states that the patient eventually developed a Pott's abscess of the dorsal spine followed by a fatal tuberculous meningitis. An autopsy was not permitted.

LESTER M. J. FREEDMAN, M.D.

Congenital Cystic Disease of the Lung. Joe Gardner. New Orleans M. & S. J. **99:** 15–21, July 1946.

This is a rather general review of the subject of congenital cystic disease of the lung. This condition the author points out has been reported under at least eighteen different designations, as follows: (1) congenital cystic disease of the lung, (2) congenital cystic formation of the lung, (3) congenital malformation of the lung, (4) atelectatic bronchiectasis, (5) congenital bronchiectasis, (6) honeycomb lung, (7) pulmonary cysts, (8) emphysematous bullae, (9) vesicular pulmonary emphysema, (10) bullous emphysema, (11) pleural blebs, (12) chronic interstitial pneumonitis with emphysema, (13) pulmonary pneumatoceles, (14) pneumatocele, (15) pneumocele, (16) pneumocyst, (17) air cyst, and (18) balloon cyst of the lung.

Though not infallible, the x-ray is the most valuable diagnostic aid. Fluid-containing cysts show up as areas of increased density. The air-containing cysts appear as areas of decreased density with fine trabeculations. By injecting lipiodol and having the patient shift position, it is possible to outline the cavity of a cyst communicating with a bronchus. Intracystic pressure reading may give some idea as to whether there is a patent connection with a bronchus.

The clinical and pathologic features of cystic disease of the lung are reviewed and a bibliography is appended. The author reports no case of his own.

Cystic Disease of the Lung. Leon Sussman. U. S. Nav. M. Bull. **46:** 1105–1109, July 1946.

The increased use of x-rays has disproved the presumed rarity of various pulmonary conditions, among

them cystic disease of the lung. This disease has been variously termed congenital bronchiolectasia, fetal bronchiectasis, congenital cystic disease of the lung, and honeycomb lung. Three cases illustrating the variations in the condition are presented here, with roentgenograms in 2 cases.

Acquired Syphilis of the Lung: Report of a Case with Autopsy Findings and Demonstration of Spirochetes. Joseph M. Wilson. Ann. Int. Med. **25:** 134–146, July 1946.

A case of acquired syphilis of the lung in a 69-year-old male is reported. The patient had four-plus Wassermann and Kahn reactions, and a roentgenogram of the chest suggested pulmonary syphilis. After administration of potassium iodide for seven weeks, x-ray examination showed a minimal regression in a right midlung density. Death was due to bronchopneumonia. Autopsy findings included, also, "syphilis of the right lung, acquired; gummata of bronchial lymph node; bronchiectasis; syphilitic aortitis."

The author considers roentgen study of pulmonary syphilis at best inconclusive, although a necessary and valuable adjunct to the clinical diagnosis. The presence in a syphilitic patient of a persistent unilateral hilar or lower lobe density with fibrous strands extending out toward the pleura, deserves serious consideration as a manifestation of pulmonary syphilis, though, other more common disease processes produce a similar picture, namely, pulmonary tuberculosis, mediastinal neoplasms, bronchiectasis, pneumoconiosis, mycotic infection, and unresolved pneumonia. Warring (Am. Rev. Tuberc. **40:** 175, 1939) is quoted as declaring that the roentgen ray is an "inadequate differentiator" of pulmonary syphilis and is convinced that this condition cannot be diagnosed clinically. Serial roentgenograms are essential in determining the response of the pulmonary lesion to antisyphilitic therapy. The author believes, however, that too great reliance should not be placed on such response, as antisyphilitic therapy may also cause regression of non-syphilitic lesions.

Bronchial Stenosis and Atelectasis from Sulphur Dioxide. W. A. Murray. Canad. M. A. J. **54:** 599–600, June 1946.

Sulfur dioxide, found where sulfur is burned, used also as a disinfectant, bleaching substance, and refrigerant, is an irritating gas, which in contact with the moisture of the respiratory tract oxidizes to sulfurous acid. Persons exposed to mild concentrations of the gas complain of headache, cough, chest constriction, and gastro-intestinal disorders. Asphyxia, acute catarrhal bronchitis, pulmonary edema, and even death may occur.

The case is reported of a 40-year-old refrigerator repair-man who experienced several attacks of cough, chest pain, and expectoration following exposures to sulfur dioxide. Successive postero-anterior films, reproduced here, showed an increased density in the left lung field, unchanged for two and one-half years (no lateral exposures are included). This was explained on the basis of a partial stenosis of the main bronchus to the left lower lobe with associated atelectasis and pneumonitis. Bronchoscopy showed no definite stenosis, but bronchography disclosed a lack of filling of the pectoral branch bronchus of the left upper lobe.

RUSSELL WIGH, M.D.

Diagnosis and Management of Severe Infections in Infants and Children: A Review of Experiences Since the Introduction of Sulfonamide Therapy. V. Staphylococcal Empyema: The Importance of Pyopneumothorax as a Complication. Gilbert B. Forbes. J. Pediat. **29:** 45–67, July 1946.

This paper is a review of 42 cases of acute staphylococcal empyema seen at St. Louis Children's Hospital from 1934 to 1943, inclusive. This series does not include cases of empyema which developed during the course of staphylococcal sepsis, nor those chronic cases which were admitted for adequate drainage. Cases of empyema following aspiration of a foreign body and those subsequent to surgical lobectomy or pneumonectomy are also excluded. Twenty-seven patients were under one year of age. None of the series received penicillin.

The onset of the underlying staphylococcal pneumonia in these cases was usually gradual. The child had an upper respiratory infection with coryza for several days, followed by fever, cough, rapid respirations, anorexia, and listlessness. Soon a rather sudden turn for the worse took place and the patient became cyanotic and dyspneic, with marked evidence of toxemia.

Physical signs of pulmonary empyema may be misleading in the young infant. The most suggestive finding is a pneumonic involvement of an entire lung field. An accurate diagnosis can be made only by fluoroscopic or roentgenographic examination. In uncomplicated staphylococcal empyema, the picture is identical with that of empyema due to other organisms except that the effusion more frequently occupies an entire lung field. The appearance of pyopneumothorax merits particular attention. A large collection of fluid and air, immobility of the corresponding leaf of the diaphragm, and rather marked displacement of the mediastinum are characteristic roentgen findings. The pocket of fluid and air may, however, be small if the pyopneumothorax has developed late in the disease and is limited by preformed adhesions, or several such pockets may be arranged in such a manner as to suggest congenital cystic disease of the lung. The presence of air and fluid in the pleural space of an infant should immediately suggest staphylococcal disease of the lung. Pyopneumothorax complicated 17 cases in this series (40.5 per cent). It was a direct cause of death in one patient and contributed in large part to the death of another.

The mortality rate for the 10 cases seen in the first half of the period under consideration was 60 per cent, and for the second period (32 cases), after sulfapyridine came into wide usage, 15.6 per cent; for the entire period 26.2 per cent.

General supportive measures and surgical drainage constituted the two most important aspects of treatment. The use of closed intercostal siphon drainage is advocated as a means of obviating the possibility of tension pyopneumothorax and at the same time providing adequate drainage. The sulfonamide drugs and antistaphylococcal serum were of limited usefulness. Ten case histories are included.

Massive Dermoid Cyst of the Mediastinum, with Report of a Case. Samuel A. Loewenberg, Samuel Baer, and William T. Lemmon. Ann. Int. Med. **24:** 1096–1105, June 1946.

Dermoid cysts may remain small or may grow rapidly in adolescence or early adult life. They usually

remain dormant until the third or fourth decade, when they begin to enlarge and produce pressure symptoms. The predominant symptoms depend upon the size of the mass and the amount of pressure exerted on contiguous structures. There are usually cough, dyspnea, and chest pain. The physical signs also depend upon the size of the tumor and upon its influence on adjacent mediastinal organs. Thus one may encounter an upper or a lower mediastinal syndrome or physical signs resembling any of the following conditions, from which a dermoid cyst must be differentiated: (1) tuberculosis; (2) pleural effusion or empyema; (3) lung abscess, bronchiectasis, pneumonitis; (4) mediastinal tumor, carcinoma, sarcoma, Boeck's sarcoid, gumma, thymoma, leukemia, Hodgkin's disease; (5) pericarditis, pericardial effusion; (6) aortic aneurysm. The differential diagnosis can be made, or at least suggested, by thorough radiological studies. Infrequently the diagnosis is established by expectoration of hair or aspiration of hair during diagnostic puncture, as happened in the authors' case. All observers emphasize the risk involved in diagnostic paracentesis.

Operation is the only method of treatment and should be performed when disquieting symptoms occur. Such operative complications as rupture of the cyst into adjoining structures, formation of a cyst-bronchial fistula, and infection of the remaining portion of a partially removed cyst, require special management.

The solid teratomata are more apt to become malignant and the dermoid cysts more frequently become infected. Rapid growth may occur in the presence of an intercurrent infection. The onset of infection in a cyst may at times be sudden, dramatic, and ominous. If the cyst communicates with a bronchus, large quantities of pus may be expectorated. A number of cases have been reported in which rupture of an infected cyst into the pleural cavity produced the clinical picture of chronic empyema.

A case is reported which presented practically all of the symptoms and signs and many of the complications mentioned above. When the patient was first seen, pericardial disease was considered a strong possibility, and this impression was supported by the presence of cyanosis, hepatomegaly, and peripheral edema. The correct diagnosis was suggested roentgenographically and confirmed by the aspiration of hair on thoracentesis.

It is generally agreed that removal of the cyst *in toto* is the treatment of choice. Since this was not possible in the authors' case, the cyst contents were evacuated and the secreting surface extensively cauterized in two stages. Eventual refilling of the cyst remains a possibility. STEPHEN N. TAGER, M.D.

Calcification of the Pleura. C. F. Taylor and L. K. Chont. J. Kansas M. Soc. **47:** 293–296, July 1946.

Calcification of the pleura is a relatively rare pathologic condition. The authors record 9 cases encountered in 6,301 patients undergoing roentgen examination for disease of the chest in seven and a half years. Tuberculosis is declared to be the causative factor by some authorities and denounced by as many others. The authors regard the calcification as the end-result either of tissue repair following degeneration, necrosis, or fibrosis, or of incomplete absorption of pleural effusion or organization of pleural hemorrhage. They believe it may be caused by any infection or trauma where the tissue damage is sufficient to be followed by hyaline degeneration, necrosis, or fibrosis. In their series, 4 patients showed definite roentgen signs of tuberculosis, and 3 of these had positive sputum. Three of the 9 patients gave a history of previous, rather severe injury to the chest wall.

The physical signs of this condition are those of pleural effusion, namely diminished fremitus, percussion, and breath sounds and, in certain cases, retraction of the thoracic cage with decrease or absence of respiratory movements. On the roentgenogram, the appearance is characteristic. Usually there are flat plaques of calcium density forming an irregular network. The lesion is usually on the lateral aspect of the lung. In advanced cases, it envelops the lateral part of the lung as a perforated shell. Retraction of the lung from the chest wall at the site of the lesion is common in advanced cases. BERNARD S. KALAYJIAN, M.D.

Angles of Clearance: A Method for Measuring the Cardiac Size of Children with Rheumatic Heart Disease (A Comparison with the Cardiothoracic Index). C. Berkeley McIntosh and Robert L. Jackson. Am. J. Dis. Child. **71:** 357–364, April 1946.

Seventy-seven children with rheumatic heart disease were studied to evaluate the relative accuracy of the angles of clearance compared with the cardiothoracic index in detecting small degrees of cardiac enlargement. The angles of clearance refer to the amount of rotation necessary to clear the left dorsal cardiac border from the transverse processes of the vertebrae and, again, from the vertebral bodies on fluoroscopic examination. The method used was a modification of Wilson's technic described in a previous report by Jackson and his associates (Am. J. Dis. Child. **68:** 157, 1944. Abst. in Radiology **44:** 514, 1945).

The patients were segregated into two sections. The first included only those children having known but inactive heart disease. Cardiac measurement was repeated over a two-year period, using both methods. The second section comprised those patients having active rheumatic heart disease. Examinations in this group were repeated every two weeks during the active phase, until the heart no longer changed in size. The purpose of this study was to determine how the two methods compared in demonstrating change in heart size.

It is concluded that the angles of clearance demonstrate a larger percentage of cardiac enlargement in rheumatic heart disease than does the cardiothoracic index, the second angle being of greater value than the first. The second angle of clearance was elevated above the high normal of 70 degrees in 68 per cent of the 77 rheumatic subjects. The first angle was above the normal of 57 degrees in 41 per cent, while the cardiothoracic index was above the normal value of 50 per cent in only 35 per cent of these patients. The greater accuracy of the angles over the index is best demonstrated in the group of subjects showing no enlargement on physical examination. Of 41 patients so classified, none had an elevated index, whereas 40 per cent had an increase of the second angle and 12 per cent had an abnormally high first angle of clearance.

Both the angles and the index followed the same trend during the active course of rheumatic fever. However, after the heart size becomes stabilized, many of the previously elevated indexes will have fallen to high normal levels while the angles of the same patients will remain increased over the upper limits of normal.

LESTER M. J. FREEDMAN, M.D.

Removal of Shell Fragment from Left Ventricle of the Heart: Report of a Case. William B. Schaefer and Victor P. Satinsky. Arch. Surg. **53:** 13–23, July 1946.

The authors report the removal of a myocardial foreign body. They point out that while there is still a difference of opinion as to the advisability of elective removal of a foreign body from the myocardium, the majority of authors favor the procedure. The dangers of permitting a foreign body to remain in the heart muscle are three: (1) cardiac rupture, (2) migration to the cardiac cavity with embolus formation or interference with cardiac function, (3) injury to the coronary vessels.

The case reported is that of a soldier who was struck by a mortar fragment in the back. A massive left hemothorax developed, in which x-rays demonstrated the presence of a metallic foreign body. Fluoroscopy showed that the foreign body moved synchronously with the heart. At operation a large amount of clotted blood and serosanguineous fluid was removed. After decortication of the lung, the heart was exposed, the foreign body was located near the apex, and removal effected. It was apparent that the shell fragment, entering posteriorly, had cut through the lung and struck the anterior chest wall, from which it was reflected to penetrate the heart. Hemostasis was secured by suture and the patient recovered, with satisfactory regression of the residua. The electrocardiograms taken postoperatively showed considerable abnormality of the ST segments, these being elevated at the beginning but later more normal in appearance. An initial diphasic T wave became a normal wave The authors stress the importance of early and consistent exercises in rehabilitation. LEWIS G. JACOBS, M.D.

Roentgen Diagnosis of Double Aortic Arch and Other Anomalies of the Great Vessels. Edward B. D. Neuhauser. Am. J. Roentgenol. **56:** 1–12, July 1946.

Anomalies of the great vessels result from persistence of normally obliterated arches or segments of the six pairs of aortic arches that develop at various times in the embryo, with disappearance of portions that should normally be present.

In the presence of a right aortic arch the aortic knob is not seen in its usual position and the aortic arch may be observed to the right of the mid-line. In the posterior type the aorta passes to the left behind the esophagus, and the descending aorta courses to the right of the normal left-sided position. In all types of posterior right aortic arch the basic deformity of deviation of the esophagus to the left with a rounded defect on the right lateral aspect and on the posterior aspect of the esophagus will be evident. In rare instances a vascular ring may be formed by the pulmonary artery and ductus arteriosus or ligamentum arteriosum. In the patient with evidence of tracheal and esophageal compression, operative intervention to relieve the constriction is imperative.

The onset of symptoms produced by a constricting double aortic arch is usually in infancy, and the patient usually presents stridulous breathing, mild dysphagia, head retraction, chronic cough, and frequent attacks of lung infection. In lateral roentgenograms it is possible to see narrowing and anterior displacement of the trachea at the level of the aortic arch. The posterior right aortic arch displaces the esophagus forward. Erosion of the anterior aspect of the thoracic vertebrae can occur. In the anteroposterior view there is a narrowing of the esophagus from both the right and left sides, due to the pressure of the vascular ring. The trachea shows a similar narrowing.

A right subclavian artery arising as the last branch of the aortic arch will in most instances pass behind the esophagus and produce a characteristic small, oblique filling defect of this organ. When the vessel passes is front of the esophagus, a similar defect is produced on the anterior aspect of this structure.

These anomalies can no longer be considered rare. Roentgenographic studies afford the only means by which a certain diagnosis can be established. Prompt surgical treatment should yield satisfactory relief of the disabling symptoms produced by esophageal and tracheal compression. CLARENCE E. WEAVER, M.D.

Anomalous Right Subclavian Artery Originating on the Left as the Last Branch of the Aortic Arch. Report of a Probable Case Diagnosed Roentgenologically. Herbert M. Stauffer and Harry H. Pote. Am. J. Roentgenol. **56:** 13–17, July 1946.

The anomalous right subclavian artery results from interruption of the right aortic arch cephalad to the origin of the primordial right subclavian. The latter then arises from the cephalic end of the unpaired dorsal aorta and passes cephalad and to the right, usually dorsad to the esophagus. The striking roentgenologic finding is the presence of a small semicircular indentation in the dorsal aspect of the barium-filled esophagus at the level of the upper margin of the aortic arch. This impression is attributed to the aneurysmal origin of the anomalous subclavian artery. The vessel courses upward and to the right. It occasionally passes between the esophagus and the trachea. The impression on the esophagus is best seen in the left anterior oblique view.

A case is described in a man aged 22 years who complained of a pulling pain in the left side of the chest, radiating to the right shoulder, which had been present on effort for seven years. There was an indentation of the esophagus on the posterior wall above the level of the aortic arch. In the anterior view there was a small convex shadow above the aortic knob on the left side, and this showed pulsation. It is postulated that in this case both the diverticulum-like origin and the esophageal imprint of the anomalous right subclavian artery itself were recognizable.

CLARENCE E. WEAVER, M.D.

Patent Ductus Arteriosus. Wm. C. Stewart. West Virginia M. J. **42:** 171–176, July 1946.

It is estimated that patent ductus arteriosus accounts for 10 to 15 per cent of all cases of congenital heart disease and that there are about 20,000 cases of this anomaly in the United States today. The author makes a careful evaluation of each of 5 cases, presenting the criteria for diagnosis and the factors influencing the treatment. He considers the mere diagnosis of patent ductus arteriosus insufficient indication for operation. Each case must be considered on its own merits and in the light of previous experience, with due consideration of what may be expected from operation or from conservative treatment and no operation.

Factors opposing surgical treatment are listed as follows: (1) The patient is quite well and has very little disability. (2) The operation is a formidable one and even in the best hands carries a certain risk. (3)

Surgery can be resorted to if subacute bacterial endarteritis develops or if manifestations of cardiac failure are present or impending. (4) In about 15 per cent of cases the ductus is found upon exploration to be inoperable.

Factors favoring surgical treatment are: (1) The life expectancy of the patient with patent ductus arteriosus is reduced by about twenty-five years, and only a very few complete a normal span of life. (2) Serious complications are almost certain to develop in the majority of patients sooner or later. (3) When the patient is in good condition, the mortality associated with surgical treatment is now very low, probably less than 5 per cent. (4) Operation after subacute endarteritis has developed will cure only about 50 per cent of patients and after congestive failure has developed the outlook is probably no better.

The author's first patient, aged nine months, was not operated upon because it was apparent that good cardiac reserve was being maintained and the child was making fairly good progress in development, was well nourished, had no cyanosis, and was able to carry out ordinary activities without difficulty.

The second patient, a twenty-one-year-old housewife, showed fairly good cardiac compensation but had a blood pressure of 120 systolic and 40 diastolic. Despite her good compensation, but because of the low diastolic pressure, she should have had surgical treatment. However, it was not possible to follow up the case and the subsequent course is unknown.

The third patient, a twenty-two-year-old man, showed an adequate cardiac reserve, enabling him to carry out ordinary exercise without dyspnea. The opinion of Dr. A. R. Barnes of the Mayo Clinic in this case is quoted: "Since his cardiac reserve is now adequate, the cardiac silhouette not enlarged, and the pulse pressure not seriously increased, and since the possibility that subacute bacterial endarteritis will develop is only a possibility, I would advise against surgical intervention at this time. In view of recent experience in the treatment of subacute bacterial endarteritis and endocarditis with large doses of penicillin, the prospect of bringing about a cure of this condition, should it arise, is exceedingly promising and hence the hazard of the occurrence of subacute bacterial endarteritis is much less formidable than formerly. If there is progressive loss of cardiac reserve prior to the age of thirty the question of surgical closure of the ductus would have to be considered."

The fourth patient, a thirty-four-year-old woman, was not operated upon in view of her normal blood pressure and good compensation.

The fifth case was that of a twenty-seven-year-old secretary, who complained of pain at the apex of the heart, aggravated at times by breathing. She experienced dyspnea on moderate exertion and was becoming progressively more dyspneic. The cardiac shadow was definitely enlarged and the heart action was very vigorous. This patient was operated upon, with successful closure of the ductus. She has experienced no difficulty since, and the heart size has diminished slightly.

In the detailed consideration of points of differential diagnosis and treatment an excellent review of the literature has been made. The roentgen examination is of great importance and may be the key to the diagnosis. Fluoroscopy is particularly useful.

J. E. WHITELEATHER, M.D.

THE DIGESTIVE SYSTEM

Effect of Transthoracic Vagotomy Upon the Functions of the Stomach and Upon the Early Clinical Course of Patients with Peptic Ulcer. K. S. Grimson, H. M. Taylor, J. C. Trent, D. A. Wilson, and H. C. Hill. South. M. J. **39:** 460–471, June 1946.

Two important mechanisms regulate gastric secretion and motility and may influence the development of peptic ulcer. One is hormonal or chemical and is usually activated by the presence of food in the stomach or duodenum. The other is nervous and responds to stimuli of neurogenic, psychogenic, or reflex nature. The visceral efferent and afferent fibers of the vagus are known to play an essential role in the neural regulation of gastric motor and secretary function.

Following the lead of Dragstedt and his associates (Proc. Soc. Exper. Biol. & Med. **53:** 152 1943; Arch. Surg. **44:** 438, 1942; Gastroenterology **3:** 450, 1944; Surgery **17:** 742, 1945; Ann Surg. **122:** 973, 1945), the authors undertook to remove a portion of the vagus nerve by the subdiaphragmatic transthoracic approach, from patients with refractory peptic ulcer. Their study of the therapeutic and physiologic effects of the procedure were begun in June 1944 and at the time of the report 25 patients had been treated. Seven had been under observation less than four months, and details concerning these are not included. In all of the remaining 18 cases the ulcers had healed without recurrence. Fifteen patients were unable to work at the time of the vagotomy; only one was still unable to work at the time of the report (nine months after operation). There were only two instances of vomiting after operation; pain and recurrent bouts of hemorrhage were relieved in all. Practically all of the patients gained weight, up to a maximum of 48 pounds, with an average gain of 16 pounds. The average duration of symptoms prior to operation was eleven years.

X-ray studies were done prior to and following operation and in no case where a crater was demonstrable before operation (8 cases) was it demonstrated after operation. The deformity at the site of the ulcer, however, persisted. The four- to six-hour retention increased remarkably after operation, and peristalsis of the stomach was described as "sluggish" in 8 cases as compared to one before. Special studies made following the introduction of a balloon into the stomach also showed a consistent decrease in the motility or peristaltic activity of the fasting stomach after vagotomy. The amount of secretion was consistently reduced, and its acidity was markedly diminished in 11 patients and moderately so in 6, the latter number including those with the greatest delay in emptying the stomach.

The authors conclude, as a result of their studies, that although vagotomy should block the neurogenic, psychogenic, or reflex gastric secretory mechanism, it may also have a broader effect and alter somewhat the endocrine or chemical secretory mechanism or facilitate neutralization of the free acid that it produces. The observations also indicate that while changes in secretion and acidity are important, the most pronounced and consistent change produced by vagotomy is a decrease of the motility of the stomach. Since the decrease of acidity was least in patients who had the greatest obstruction by scar tissue, and the greatest delay in emptying the stomach, it seems probable that vagotomy should often be combined with pyloroplasty or gastrojejunostomy if the maximum benefit is to be obtained.

SYDNEY F. THOMAS, M.D.

Trans-Pyloric Prolapse of Redundant Gastric Mucosal Folds. W. C. MacKenzie, J. W. Macleod, and J. L. Bouchard. Canad. M. A. J. **54:** 553–558, June 1946.

Two cases of proved transpyloric prolapse of redundant gastric mucosal folds are added to the literature. The etiology of this condition is unproved, but preexisting gastritis and emotional factors are believed to play important roles. The author distinguishes two types of roentgen picture—the polypoid and the pyloric narrowing type. In the former, prominent rugae are seen running in every direction, and there is a rounded defect in the base of the duodenal cap. In the latter type, which is more unusual, there is constant and persistent narrowing of the prepyloric region, but, in spite of this, the appearance is not that of a true stenosis. It is rather that of a definite diminution of caliber without appreciable interference with the passage of the peristaltic waves, and without secondary dilatation of the stomach. The pylorus itself seems to be moderately elongated and perhaps broader than usual. The base of the cap may show a concave outline with or without a definite filling defect as in the former type. The mucosal pattern is difficult to demonstrate, but with pressure or with the patient supine one may sometimes make out a localized area of redundancy in the prepyloric rugae. Among conditions to be considered in the differential diagnosis are a prolapsing polyp and early prepyloric carcinoma.

Operation is indicated only if a polyp cannot otherwise be ruled out, if bleeding continues, and if there is evidence of pyloric obstruction.

FRANCIS F. HART, M.D.

Congenital Duodenal Obstruction. Roentgen Diagnosis by Insufflation of Air. Harry Z. Mellins and Doris H. Milman. Am. J. Dis. Child. **72:** 81–88, July 1946.

Because of the significant improvement in results of surgical management of congenital duodenal obstruction, early roentgen diagnosis is important. The roentgen diagnosis is usually made with barium sulfate or swallowed air as the contrast medium. The danger of using barium sulfate lies in possible plugging of the anastomotic stoma, to be created in a future short-circuiting procedure and in the development of aspiration pneumonia.

Plain roentgenograms of the abdomen may be used, but are subject to the limitation that in the first twelve to twenty-four hours the stomach and duodenum may be only slightly dilated and the duodenal curve may be poorly outlined by air. Thus accurate localization of obstruction will not be possible.

The procedure used by the authors is as follows. After plain roentgenograms of the abdomen are taken, a Levin tube is passed into the infant's stomach and the gastric contents are aspirated. Then 60 to 90 c.c. of air are introduced under fluoroscopic guidance. The infant is rotated to the left and "spot" films are taken. At the end of the procedure, the air is aspirated.

Two cases of duodenal obstruction, one intrinsic and the other extrinsic, are presented, together with roentgenograms and autopsy findings confirming the preoperative diagnoses. PAUL W. ROMAN, M.D.

Duodenal Obstruction Complicating Cholecystectomy. Theodore L. Vosseler and Allison J. Vosseler. Am. J. Surg. **72:** 121–124, July 1946.

An eighteen-year-old girl, who had complained of vomiting most of her life, was subjected to a cholecystectomy, at which time nothing abnormal was found except an "hour-glass" gallbladder. Postoperatively, she continued to vomit and showed symptoms of upper intestinal obstruction. X-ray examination with a small amount of barium passed through a Miller-Abbott tube showed partial obstruction in the distal third portion of the duodenum.

A second laparotomy was performed twenty-three days after the cholecystectomy, at which time changes were noted in the region of the duodenal-jejunal junction. These changes suggested an inflammatory process. Due to the poor condition of the patient, the operative wound was closed without further procedure. Slowly she regained intestinal function and was discharged from the hospital, improved, on the fifty-seventh day. She became strong and robust and had remained so for six and one-half years at the time of the report. VERN W. RITTER, M.D.

Malignant Lesions of the Duodenum. Claude F. Dixon, A. L. Lichtman, Harry M. Weber, and John R. McDonald. Surg., Gynec. & Obst. **83:** 83–93, July 1946.

The authors discuss and analyze 49 cases of malignant lesions of the duodenum exclusive of those found in the region of the papilla of Vater. Forty-four cases proved to be carcinoma, 2 sarcoma, 2 leiomyosarcoma, and 1 lymphangioendothelioma. The pathogenesis of malignant duodenal lesions is considered with respect to trauma, malignant degeneration within ulcers, primary malignant growth within Brunner's glands, and malignant degeneration of aberrant pancreatic tissue.

In the main, the patients were men in the sixth or seventh decade. Fourteen of the lesions occurred in the first part of the duodenum, 15 in the second, and 20 in the third part. Thirty-eight of the patients gave a history of obstructive symptoms and in 6 cases the principal finding was anemia due to loss of blood either by mouth or bowel.

Since 1939 duodenal neoplasm has been found in 20 cases and in every one the existence and location of the lesion were correctly determined by roentgenograms. In 12 of these cases subsequent pathologic examination confirmed the roentgen diagnosis. The roentgenologic criteria are identical with those for malignant lesions in other tubular portions of the gastro-intestinal tract.

Forty-five patients were operated on, but in 37 only exploration was done. The operative mortality rate due to procedures other than exploration was 22 per cent. Four patients underwent radical resection and 4 others segmental resection; local excision was done in one. N. P. SALNER, M.D.

Jejunal Cancer—A Case Report. Imre Braun. Am. J. Digest. Dis. **13:** 234–237, July 1946.

Primary malignant tumor of the small intestine is an infrequent lesion. It is usually an annular adenocarcinoma, constricting in type, metastasizing early to the mesenteric lymph nodes. The chief symptoms are cramps and epigastric discomfort, with spells of nausea and vomiting. The presence of occult blood in the stool is a valuable sign. "X-ray examination may be of great help in establishing a correct diagnosis, though the use of barium by mouth may constitute a definite hazard by completing an otherwise incomplete obstruction."

The treatment of choice is resection with entero-

anastomosis. If this is not possible, entero-anastomosis with exclusion or temporary enterostomy is advised for palliation. The operative mortality is about 20 per cent, and the duration of life following operation averages only 17.6 months. Nevertheless, the relief of obstruction and the comfort of the patient justify the surgical procedure.

The author's patient was a 53-year-old white woman who, two years before, started losing weight. At the time she consulted the author she had lost 24 pounds. The symptoms began with indefinite abdominal distress unrelated to meals and unaffected by alkalies. After a year, there were attacks of excruciating abdominal pain, radiating from the umbilicus to the left upper quadrant, accompanied by nausea and vomiting.

Barium was given and a one-hour examination showed a marked distention of the small bowel. The six-hour examination showed the stomach to be empty and the small bowel markedly dilated to an area of deformity. A twenty-four-hour film showed the same findings. A diagnosis of an obstruction of the small bowel due to a neoplasm was made from the x-ray films.

The obstructing lesion was removed, together with a wedge-shape piece of omentum. Pathological section showed adenocarcinoma of the small intestine affecting all coats. The patient was living seventeen months after the operation, without evidence of recurrence.

JOSEPH T. DANZER, M.D.

Roentgen Diagnostic Methods for Detection of Colonic Lesions. Martin L. Tracey. S. Clin. North America **26:** 603–605, June 1946.

The method of choice for determining the location and extent of colonic lesions above the sigmoid is roentgenography following a barium enema. The rectum and rectosigmoid seldom present positive findings except in large, far advanced lesions. Therefore, with (1) any change in bowel habits, (2) any unexplained rectal bleeding, and (3) anemia without visible bleeding, a digital and proctosigmoidoscopic examination should precede the barium enema. It is wise, even with visible anal lesions, to rule out ulcerative, inflammatory, and neoplastic conditions in the upper colon.

The author does not feel that preparation is necessary, since this may mask functional disturbances of the colon by promoting spasm and irritability, and since "no greater number of lesions are overlooked by doing the barium enema without preparation than with preparation." The experienced roentgenologist who visualizes a suspicious area may, however, wish to recheck it with preparation and an air contrast film. A suspicious area demonstrable both with and without preparation in the same location is excellent positive evidence. Preparation and air contrast studies are necessary for polyps and small lesions when suspected and undetected in the unprepared colon.

The mechanics of the examination of the colon are given in detail, and those inexperienced in the roentgenoscopic examination of the colon should carefully read this section of the short article, as it is quite lucid. The use of spot films with cone pressure is recommended as bringing out detail and recording more intracolonic lesions.

"To be noted in diagnosis of irritable colon are rate of flow, hesitation, and spasm, dilatation, extreme distress, absence of sensation of filling, tenderness confined to the colon, mass peristalsis, and the amount of barium used (normal 1,000 to 1,500 c.c.)."

When severe distress or spasm follows introduction of the barium, it should be expelled, and a second examination should be undertaken. Because of the antispasmodic effect of the initial barium, a second attempt is likely to be successful.

For examination with a double contrast air enema, preparation is essential. If castor oil or citrate of magnesia, 6–12 oz., is ineffective, a soapsuds or saline enema should be given an hour or two before the examination.

When the patient does not retain the double contrast enema, some information may be obtained by observing the colon at three, six, and twenty-four hours after a barium enema, or even with the aid of a barium meal followed by a saline cathartic. For the diagnosis of localized areas in the cecum and ascending colon, a Miller-Abbott tube may be passed into the lower ileum and a small amount of dilute barium introduced to outline the area, or a Rehfuss tube may be passed into the duodenum and a small intestinal barium enema given.

SYDNEY F. THOMAS, M.D.

Diagnosis of Carcinoma of the Colon and Rectum. Neil W. Swinton and J. Lawrence Gillespie. S. Clin. North America **26:** 553–563, June 1946.

Swinton and Gillespie point out that in no other field of surgery has such gratifying progess been made as in the field of surgery of the colon and rectum. The resectability rate in the Lahey Clinic, from which this report comes, is now 85 per cent and the five-year survival rate 50 per cent. Unfortunately there has been little or no change in the interval between the onset of symptoms and the establishment of the diagnosis of cancer. In order that this may be reduced, the following recommendations are made:

1. Increasing attention must be paid to symptomatology.
2. The differential diagnosis from non-malignant lesions must be appreciated.
3. The indications for digital examination of the rectum, sigmoidoscopic study of the rectum and lower sigmoid, barium enema, and air contrast radiography of the rectum and colon must be understood.
4. A constant search for and the removal of premalignant lesions must be undertaken.
5. An accurate diagnosis of cancer must be made at the earliest possible time.

The authors divide the symptomatology on the basis of lesions arising in the right colon and the left colon. The lumen of the bowel on the right side is considerably larger than on the left, and obstructive signs therefore appear late in right colonic lesions but early when the left side is involved. Lesions of the right colon are accompanied by anemia in a high percentage of cases; pain is also a prominent symptom, but a palpable tumor is present in only a few cases. Abnormalities of the stool constitute the chief symptom of rectal carcinoma and demand scrupulous examination. They include the presence of blood, pus, or mucus, as well as any change in caliber of the stool.

In view of the fact that 70 per cent of surgical procedures on the large bowel in the Lahey Clinic are for malignant tumors, the authors consider it justifiable to regard any unproved lesion of the colon as cancer until some other diagnosis is established. Among the lesions to be considered in the differential diagnosis are: chronic, stenosing, regional enteritis; diverticulosis and diverticulitis; tuberculosis of the ileocecal region; benign polyps; volvulus; sarcoma; non-specific granu-

lomas and benign tumors other than polyps. In the rectum, hemorrhoids, abscesses, and other anorectal conditions must always be considered in the differential diagnosis of malignant disease.

Polyps are regarded as a definitely premalignant condition. Because of this, their early recognition is of vital importance. Radiographically they are best demonstrated by a contrast air enema [see following abstract]. Actually they are demonstrable sigmoidoscopically in a large proportion of cases and, since they are usually symptomless until malignant change occurs, sigmoidoscopy is recommended as a part of every complete physical examination.

The failings of the roentgen examination of the more distal portions of the colon and rectum are emphasized and re-emphasized, as they should be, especially as 70 per cent of malignant growths of the colon occur within the reach of a 10-inch sigmoidoscope.

SYDNEY F. THOMAS, M.D.

Use of Double Contrast Enemas in Lesions of the Colon. Magnus I. Smedal. S. Clin. North America **26:** 594–602, June 1946.

Smedal points out the usefulness of air as a contrast medium in conjunction with barium, especially in dealing with polyps or polypoid lesions of the colon, where the amount of disturbance of the lumen is minimal. In a previous review of 827 cases of cancer of the colon and rectum, 14 per cent were found to have arisen on the basis of a pre-existing polyp (Swinton and Warren: J. A. M. A. **113:** 1927, 1939). With a double contrast enema and stereoscopic views, a much more complete picture of the colon is obtained than following the ordinary barium enema. Preparation of the patient with castor oil is one of the prime necessities for an adequate double contrast examination. The author also stresses the use of the after-evacuation air-contrast study as a valuable adjunct to the routine stereoscopic film with the bowel dilated with air.

Diverticulitis with superimposed carcinoma can be differentiated quite frequently by the use of double contrast studies. A film is reproduced, in which the definitely irregular shelving margin characteristic of carcinoma is seen through the areas of narrowing due to the diverticulitis.

[The author does not mention the use of a supine stereoscopic view for delineating more clearly the rectum and lower colon, nor does he mention the use of oxygen instead of air to reduce the incidence of cramps, especially in patients who have difficulty in retaining air.]

SYDNEY F. THOMAS, M.D.

Interposition of the Colon Between the Liver and Diaphragm (the Chilaiditi Symptom). O. Hubacher. Schweiz. med. Wchnschr. **76:** 554–559, June 22, 1946.

The author studied the incidence of interposition of the colon between the liver and diaphragm, first described by Demetrius Chilaiditi in 1910. In a series of 25,000 roentgen studies, consisting of 20,000 serial fluoroscopic observations and 5,000 films, there were 22 examples of this abnormality, 0.088 per cent of the series. This is a rather lower incidence than has usually been recorded. The condition is believed to be congenital in origin. The clinical symptoms are interesting. They may consist of a subileus or a chronic constipation or in an elevation of the diaphragm leading to cardiac compression with abnormalities in the electrocardiogram. These findings are rather rare, however, even when the abnormality is present. A clinical diagnosis is rarely made, since it depends on percussion of the air in the colon and the air content is inconstant.

Several case histories are included.

LEWIS G. JACOBS, M.D.

Hepatodiaphragmatic Interposition of the Colon with Gastric Hypertrophy. Case Report. Eli Starr. Am. J. Roentgenol. **56:** 22–26, July 1946.

Hepatodiaphragmatic interposition of the colon has been reported by various observers to occur in about one per one thousand cases. Usually it is discovered as an incidental finding. It has been mistaken for free air under the diaphragm due to perforation of a hollow viscus. The presence of haustral markings is a differential sign, especially helpful when the markings are seen in both erect and prone views. The presence of a fluid level in the upright position would indicate that, in addition to the meteoric hepatic flexure, there were free air and fluid in the right subphrenic space. When clinical findings indicate laparotomy, interposition should not preclude surgical intervention.

Constipation and flatulence are direct symptoms. Indirect symptoms are dyspepsia, pyrosis, nausea, regurgitation, and vomiting. The downward and left displacement of the liver compresses the pyloric end of the stomach and the first portion of the duodenum, producing gastric retention, distention, eventual hypertrophy, and possibly ulcerations. It was believed by Bürger (Klin. Wchnschr. **4:** 102, 1925) and Weiland (Munchen. med. Wchnschr. **62:** 537, 1915) that perforated gastric ulcer is the primary disease, of which the interposition is a sequel.

A case is reported of a young soldier who showed interposition on a routine chest examination. Roentgenological examination of the stomach and duodenum showed extrinsic pressure upon the lesser curvatures of the stomach and duodenal cap. Mucosal folds were hypertrophic and peristalsis was active. This patient complained of constipation and bloating, occasional heartburn, and gaseous eructation. It was felt that the gastric enlargement and hypertrophy were due to hepatic pressure upon the stomach and duodenum.

CLARENCE E. WEAVER, M.D.

Some Observations on Radiology of the Pancreas. R. A. Kemp Harper. Proc. Roy. Soc. Med. **39:** 534–537, July 1946.

Radiology has come to play an important part in the recognition of pancreatic disease. One cannot emphasize too strongly the necessity for looking for evidence of such disease in all obscure cases with upper abdominal symptoms. A routine barium meal study with full examination of the duodenum, as well as the stomach, is the most satisfactory method of roentgen study, though gastric pneumography may be of assistance in selected cases as an additional aid.

Calcification of the body of the pancreas is occasionally encountered, and *calculi* have been reported in the ducts. Six types of *cystic enlargement* have been described (Porta and Roversi) as follows:

1. Cyst of the head—enlarging and flattening the duodenal loop and causing pressure deformity of the antrum.

2. Cyst of the body—frequently displacing the stomach upward.

3. Cyst of the tail—displacing the greater curvature medially and the transverse colon downward and laterally.

4. Gastrohepatic type which displaces the lesser curvature downward and often the third part of the duodenum and transverse colon also.

5. Gastrocolic type, displacing the stomach medially and the transverse colon distally.

6. Mesocolic type, displacing the stomach and transverse colon proximally.

Carcinoma occurs most frequently in the head of the pancreas. Its diagnosis depends on the deformity produced and infiltration of the stomach and duodenum. When the lesion is situated in the region of the ampulla, it may produce the reversed 3 sign described by Frostberg (Acta radiol. **19:** 164, 1938. Abst. in Radiology **32:** 381, 1939), but this occurs in a fairly small proportion of cases of carcinoma and may be present in other types of pancreatic enlargement. Widening of the duodenal loop and a pressure effect are insufficient evidence on which to base a diagnosis of carcinoma, although frequently they constitute the only radiological signs for a long time. The additional factor of erosion or invasion of the duodenal wall or stomach must be observed before making the final diagnosis. Occasionally enlargement occurs high up in the head of the pancreas and produces a fairly characteristic sickle-like appearance of the duodenum. With invasion of the antrum of the stomach difficulty in differentiation from a gastric carcinoma may be considerable unless enlargement of the head of the pancreas is marked.

Chronic pancreatitis produces enlargement of the gland without duodenal or gastric invasion. Radiological differentiation from carcinoma may be difficult.

Enlargement of the prepancreatic lymph nodes secondary to gastro-intestinal cancer or due to Hodgkin's disease or lymphosarcoma must be differentiated from intrinsic disease of the pancreas, as must retroperitoneal sarcoma. SYDNEY F. THOMAS, M.D.

Aberrant Pancreas. Arthur J. Present. Am. J. Roentgenol. **56:** 55–57, July 1946.

Aberrant pancreatic tissue in the gastro-intestinal tract is of sufficient frequency to warrant its consideration in the differential diagnosis of so-called "filling defects" noted in barium studies. Most of the nodules are small and symptomless. Cases have been reported, however, in which the ectopic tissue caused or was associated with obstruction and intussusception. Pancreatitis, malignant change, or proliferation of islet tissue producing hyperinsulinism may also occur. The most frequent site is the stomach or duodenum.

Two cases are reported. In one there was a large intramural tumor of the gastric antrum. The patient complained of loss of weight, intermittent nausea, vomiting, and hematemesis. There was delay in gastric emptying. The second case presented the fairly typical elements of a polyp and probably produced no symptoms. In neither instance was the true nature of the condition recognized preoperatively.

CLARENCE E. WEAVER, M.D.

THE MUSCULOSKELETAL SYSTEM

Radiological Aspects of Various Forms of Dwarfism. Giulio de Giuli and Leonardo Ducci. Riv. di. clin. pediat. (Firenze) **44:** 321–352, July 1946.

The authors analyze the different definitions of dwarfism which have been given by Nobecourt, Roessle, Bochardt, and Schinz, and attempt to differentiate various forms of the condition according to the radiological appearance. Their presentation is based upon the study of 10 cases, including instances of osteomalacia, rickets, osteogenesis imperfecta, achondroplasia, hypophyseal deficiency with Cushing syndrome, hypothyroid dwarfism with myxedema, premature closure of epiphyses, and sexual disturbances.

Radiological examination has been found to allow the division of cases of dwarfism into three groups: (1) cases in which the bone growth is retarded (essential dwarfism, endocrine dwarfism); (2) cases in which one finds actual alteration of the epiphyseal cartilages (achondroplasia, rickets, chondrodysplasia); (3) cases in which there are no alterations of the chondral ossifications (osteomalacia and fragilitas ossium).

The inclusion of osteomalacia and of fragilitas ossium in dwarfism is rather confusing, because the short stature of the patients is due to bowing or fractures of the long bones and not to true shortening. This inclusion, however, may be useful, from a clinical standpoint.

CESARE GIANTURCO, M.D.

Periosteal Reaction, Fever and Irritability in Young Infants. A New Syndrome? Francis Scott Smyth, Alice Potter, and William Silverman. Am. J. Dis. Child. **71:** 333–350, April 1946.

A new syndrome in infants and young children is suggested by the authors, characterized by secondary anemia, leukocytosis, low fever, irritability, and periostitis of the flat and long bones of several months' duration.

Seven cases are presented, 5 in boys and 2 in girls, the ages ranging from three months to two and a half years. Symptoms were present one to several months prior to admission. All of the 5 young infants had swelling or brawny induration of the face and were markedly irritable when touched or handled. Four of these infants showed periosteal new bone formation of the mandible, and one of the two older children showed similar changes of the nasal bones roentgenologically. Other bones commonly involved included the clavicles, ribs, and long bones of the extremities. Except in one instance, the roentgen findings were marked and show clearly on the reproductions, although the general quality of the latter is only fair. The findings varied from simple elevation of the periosteum and onion-skin lamination to a massive sclerosis.

Physical examination revealed tender swelling or induration over the bone lesions, although in several instances swelling was present without roentgen abnormality in the underlying bone. Three patients had a concurrent mild upper respiratory infection with a questionable otitis media suspected in one case. Incidentally, a provisional diagnosis of otitis media was made in several of the infants, prompted by the fever and tender facial swelling. This diagnosis was altered when no change in status occurred during or following sulfonamide therapy.

Diagnostic studies failed to identify this syndrome with any known disease entity. Biopsy showed fibrosis, degeneration, and atrophy of skeletal muscle. Bone biopsy in one case showed an irregular proliferating cartilage line, with irregular cell clumps instead of the usual cell columns, periosteal new bone formation, and increase of fibrous tissue in the marrow. The findings were considered similar to those in osteitis fibrosa and muscular dystrophy.

In the differential diagnosis, scurvy was eliminated because of the lack of roentgen evidence at the ends of the long bones, absence of subperiosteal hemorrhage, and failure of response to massive vitamin C therapy checked with ascorbic acid blood level determinations. Syphilis and tuberculosis were ruled out by noncontributory family histories, biopsy findings, and repeatedly negative serologic and tuberculin tests. Nonspecific infection was considered because of the fever, leukocytosis and concurrent upper respiratory disease. However, response to sulfa therapy was poor, the distribution of the bone lesions was widespread, suggesting a metabolic rather than a local disease, and no pathogenic organism was recovered by culture of material from the nose, throat, urine, blood, or biopsy. It is admitted that no virus studies were made. Traumatic periostitis and pulmonary osteoarthropathy are discussed, but these possibilities appear remote.

The course of the disease was protracted for several months, but complete recovery occurred in each case.

Reports of atypical scurvy and of unusual periostitis were culled from the literature and are discussed by the authors, who consider them to be examples of the syndrome presented above.

LESTER M. J. FREEDMAN, M.D.

Multiple Myeloma Simulating Hyperparathyroidism. Dorothy Gill. Ann. Int. Med. **24:** 1087–1093, June 1946.

The appearance of a high blood calcium in such conditions as multiple myeloma and metastatic carcinoma of bone has led to speculation as to whether this is simply incident to diseases causing rapid bone destruction or whether true hyperactivity of the parathyroid glands exists. The author's case of multiple myeloma is of interest since the parathyroid glands were grossly and histologically normal, though a marked hypercalcemia was present.

Roentgen rays of almost the entire skeleton were taken and showed various extensive areas of destruction involving the pelvis, lumbar spine, humerus, femurs, ribs, clavicles, and skull. Many of the lesions were punched-out in type. Other areas were diffusely decalcified, with good trabeculation. Various selected rib lesions were exactly like those of metastatic carcinoma, while others in the long bones resembled those of multiple myeloma. The consensus of radiological opinion, however, was in favor of osteitis fibrosa cystica.

A diagnosis of hyperparathyroidism having been made, the patient, a 38-year-old housewife, was submitted to exploration of the neck. Two inferior parathyroid glands were located and a subtotal resection of the right plus a total resection of the left was performed. These proved on histological examination to be of normal structure. The superior parathyroids were not demonstrated. A bone marrow biopsy was then belatedly performed and yielded a red, gelatinous material which showed 72 per cent typical myeloma cells. Autopsy showed extensive replacement of bone marrow with myeloma cells. No further parathyroid tissue was found.

The clinical and laboratory findings common to both multiple myeloma and hyperparathyroidism which were present in this case were as follows: progressive weakness and anemia, bone pain, abdominal pain, vomiting, bone cysts, and pathological fractures demonstrable by roentgen ray, and high blood calcium. Findings frequently present in multiple myeloma, but absent here, were Bence-Jones proteinuria, elevated total serum proteins, reversed albumin-globulin ratio, and evidence of kidney insufficiency. Findings frequently present in hyperparathyroidism, but absent or doubtful here, were a low blood phosphorus, a negative calcium balance (high urinary calcium excretion), and increased blood phosphatase. In this case, one blood phosphorus determination was definitely low (2.22); the others low normal. Only postoperatively did the phosphatase level rise above normal. A history of kidney stones in the past was quite suggestive of hyperparathyroidism.

If pitfalls in diagnosis are to be avoided where much overlapping of clinical and laboratory findings occurs, and where hypercalcemia is the only constant feature, it is obvious that all possible diagnostic procedures should be undertaken at the outset.

STEPHEN N. TAGER, M.D.

Critical Study of Chronic Vertebral Rheumatism. A. P. Lachapèle. J. de radiol. et d'électrol. **27:** 285–312, 1946.

The author considers the growth of various concepts of vertebral arthritis, and goes on to a discussion of the different types under the names that have come into common usage.

Rhizomelic Spondylosis: This is the form usually referred to as Marie-Strümpell arthritis, and the cardinal diagnostic point is ligamentous ossification along the spine, producing the so-called "bamboo spine." Other concomitants have been pointed out by various authors and deleted by others. It often seems a part of the entity known as rheumatoid arthritis, though in some instances it lacks most of the febrile manifestations of this type. Early closure of the inferior borders of the sacroiliacs is often mentioned. [Oppenheimer has called attention to the fact that ligamentous ossification may occur in connection with several distinct disease entities, so that it does not deserve classification as an entity in itself.]

Chronic Osteophytic Rheumatism: This is ordinary osteoarthritis, though the author's description is involved, and the meaning not too clearly brought out.

Traumatic Spondylitis: This designation the author confines to what has been called Kümmell's disease. [This so-called entity is now, I believe, generally recognized by orthopedic surgeons as an overlooked compression fracture.]

Spondylarthritis Due to Known or Unknown Organisms: This group includes osteomyelitis, typhoid spine, arthritis of undulant fever, meningitic arthritis, that due to typhus, gonococcus, pneumococcus, etc.

Poorly Classified Chronic Arthritides: Indistinct entities, osteoporosis of the spine, the facet syndrome, and others the author does not consider are well enough established to be given an unquestioned place in his classification.

The author's first illustration (anteroposterior view) will call forth contradictory opinions. It is one in which two lumbar vertebrae are bridged along the sides and which is typically an osteoarthritis. This change he attributes to pneumonia.

Another case in which a vertebra gradually narrowed until only a wedge was left (the disk above and below not appearing to be involved) suggests very strongly a compression fracture in an osteoporotic spine, with some possibility of a metastatic lesion. The author designates this one as due to "grippe."

All the rest of the illustrations fit quite easily into our

classifications of Marie-Strümpell arthritis, or osteoarthritis, or of another group very aptly named, though not yet very widely recognized, as "discogenetic." Another group, suggested once or twice in the series, has been grouped for some time by orthopedic surgeons as "hyperextension injury."

PERCY J. DELANO, M.D.

Myelography in Patients with Ruptured Cervical Intervertebral Discs. Francis Murphey, Lucien M. Pascucci, William H. Mead, and Benjamin R. Van Zwaluwenburg. Am. J. Roentgenol. **56:** 27–42, July 1946.

Recently it has been established that lateral rupture of the cervical intervertebral disks producing pain in the neck, shoulder, and arm is a fairly common lesion. The authors' experience is based on 62 cervical myelograms, 28 per cent of which were positive, with 16 verified at operation. Lateral herniation may result from slight or severe trauma or it may appear without any recognizable injury. These lesions have been classified into two types: (1) the soft extruded nodule of nucleus pulposus which may later undergo degeneration and calcification and, when calcified, is often wrongly interpreted as an arthritic spur; (2) protrusions of the disk without rupture of the annulus fibrosus or extrusion of the nucleus.

For myelography, 6 c.c. of pantopaque is injected between the fifth lumbar and first sacral segments, and under roentgenoscopic control this is allowed to flow into the cervical region. Exposures are made in frontal and oblique positions. The opaque material is removed from the lumbar area after the examination is completed.

The authors stress the importance of a preliminary plain-film examination. The following abnormalities are to be looked for in the plain roentgenograms: (*a*) scoliosis; (*b*) straightening or reversal of the normal cervical curve; (*c*) calcification in the posterior joint space; (*d*) encroachment on the intervertebral foramen by a soft-tissue shadow and/or osteophyte; (*e*) localized arthrosis. It is believed that a significant number of cases of arthrosis are a result of injury to the disk rather than due to degenerative arthrosis.

Although preliminary examination gives adequate information about the intervertebral joint space, the myelogram, from a roentgenologic standpoint, is in most cases necessary for demonstrating protrusion or herniation of the nucleus pulposus. Four types of lesions were seen most commonly in the myelograms in the authors' series: (1) The shallow "half-moon" defect with an irregular or smooth base; the nerve root may be broadened or obliterated; (2) the triangular defect with a clear-cut lower border and less distinct upper border; (3) the poorly circumscribed "pressure" defect due to compression of the spinal cord with obliteration of the nerve root; (4) the large irregular "gap" defect, sometimes extending to the mid-line.

A high degree of accuracy in roentgen diagnosis was possible only by correlating the clinical and myelographic findings. It seems justifiable to conclude from the evidence thus far obtained that the negative cervical myelogram bears more weight than the negative lumbar myelogram. Positive cervical myelographic findings have proved highly accurate in the authors' series of operated cases. In many cases the diagnosis can be made on the basis of the clinical findings.

CLARENCE E. WEAVER, M.D.

Prespondylolisthesis. A Study of Twenty-Three Cases. Paul E. McMaster and Fred M. Dula. U. S. Nav. M. Bull. **46:** 1077–1082, July 1946.

Twenty-three cases of symptomatic prespondylolisthesis, occurring in a group of 350 consecutive patients with low back pain seen during a seven-month period, are discussed. In the same group were 6 cases of spondylolisthesis, thus indicating a preponderance of almost four to one of the so-called "pre-slipping stage" over the stage of actual slipping. All patients were males in the military service. Nine dated the onset of symptoms from an injury, while the others stated that the back pain developed gradually without primary trauma. Physical examination showed moderate to fairly marked lumbar muscle spasm and corresponding limitation of spinal motion, especially flexion and extension, in all but 5 cases. Tenderness to percussion at the lumbosacral area was present in all. The diagnosis of "prespondylolisthesis" was established roentgenologically, with the demonstration of a defect in the neural arch between the superior and inferior articular processes. In all suspected cases multiple views were taken in various planes—anteroposterior, lateral, and right and left oblique. The fifth lumbar was involved in 12 cases, the fourth in 2, a lumbarized first sacral segment in 7, and a combination of the fourth and fifth lumbar in 2. In 17 cases the defect was bilateral. In none of the 23 patients was there definite evidence of a herniation of the nucleus pulposus, such as roentgen demonstration of a narrowed disk, or lower extremity motor, reflex, or sensory change.

Spondylolysis and Its Relation to Spondylolisthesis M. P. Rhodes and C. Colangelo. Am. J. Surg. **72:** 20–25, July 1946.

Spondylolysis literally means dissolution of all or part of a vertebra, but through common usage it has become synonymous with defects in the neural arch. This condition is present in all cases of spondylolisthesis but may occur without actual "slip" of the vertebral body. Roentgen examination in the lateral and oblique positions is pointed out as the only reliable method of diagnosis of spondylolysis. Attention is directed to the necessity of distinguishing the defect from fracture of the isthmus and from accessory ossicles of the inferior articular processes. Conditions which are clinically similar to but roentgenologically different from spondylolysis are subluxation of the apophyses, arthritis of the apophyses, and various forms of disk disorders. The authors caution against "overreading" studies of the low back lest pathologic significance be ascribed to insignificant variations in a region where the normal appearance is of such wide variability. They examined 1,250 low backs and in this group found 60 cases of spondylolysis, 34 of which were complicated by the coexistence of spondylolisthesis; 26 of these 34 cases showed first-degree displacement. The usual clinical findings and methods of therapy are discussed.

PAUL W. EYLER, M.D.

Fusion of Vertebrae Following Resection of the Intervertebral Disc. S. L. Haas. J. Bone & Joint Surg. **28:** 544–549, July 1946.

An intervertebral disk in the lumbar region was removed from each of six dogs of various ages, and the operative site was re-examined after 120 to 146 days. In all but one instance complete bony fusion developed between the bodies. In the exceptional case, fibrous

union was strong enough to prevent movement between the bodies, but the zygapophyseal joints did show motion.

Where union of the two vertebrae occurred, the total length of the fused bodies was less than before removal of the disk, and there was a tendency toward dorsal buckling at the site of union.

The process of union between the vertebral bodies is similar to the process of union in fractures.

JOHN B. MCANENY, M.D.

Bilateral Recurrent Intercarpal Subluxation. Charles J. Sutro. Am. J. Surg. **72:** 110–113, July 1946.

The author presents 2 rather unusual cases of painful wrists which were found to be due to recurrent dislocation of some of the carpal bones in relation to the others. The subluxations occurred only with movements of the wrist and were bilateral and not connected with trauma but were definitely associated with a clicking sound and were followed by swelling due to joint effusion after the motions had been repeatedly carried out. The subluxations, demonstrated by both films and fluoroscopy, in one instance involved the capitate bones, which dislocated anteriorly, and in the other consisted of an anterior subluxation of the entire distal row of carpal bones and their adjacent metacarpals with respect to the proximal row of carpal bones. The first case was treated by surgical arthrodesis and a very satisfactory result was achieved. Therapy in the other case is not reported.

The author's hypothesis is that the condition is brought about by excessive length of the ligaments binding the carpal bones and an imbalance of power between the flexor and extensor apparatus of the fingers and hand.

PAUL W. EYLER, M.D.

Some Observations on the Fractured Carpal Scaphoid. John J. Bedrick and Sigmund A. Zawadzki. Mil. Surgeon **98:** 488–491, June 1946.

This is a study of 31 carpal scaphoid fractures seen in a military hospital during a thirty-six months' period. Roentgenograms were taken in the anteroposterior, lateral, and oblique positions with the hand in ulnar deviation, and comparative studies of the other wrist were made in doubtful cases. If clinical signs were severe, even when roentgenograms were negative, the injury was treated as a fracture and roentgen examination was repeated in ten days. Nineteen of the 31 scaphoid fractures were fresh; 18 of these went on to bony union following simple immobilization for periods of twelve to sixteen weeks, while in the nineteenth case there was non-union and operative intervention was necessary. The remaining 12 cases were old, ununited fractures which had been missed for periods ranging from six to eighteen months; all required operative intervention.

Eosinophilic Granuloma of Bone. Report of a Case Involving the Clavicle. R. Beverly Ray and Aaron Kellner. J. Bone & Joint Surg. **28:** 629–634, July 1946.

Eosinophilic granuloma of the clavicle has been reported previously, but its occurrence is rare enough to warrant presenting a single case. A 22-year-old soldier complained of pain, tenderness, and swelling at the proximal end of the left clavicle. Four weeks later, a roentgenogram showed a destructive lesion at the sternal end of the left clavicle, thought to be an acute osteomyelitis. The patient was transferred to another hospital, and further study suggested a new growth with a soft-tissue mass, possibly malignant. Biopsy of the lesion showed eosinophilic granuloma.

Eosinophilic granuloma may simulate almost any bone lesion, inflammatory or neoplastic. The solitary lesions may suggest a cyst, giant-cell tumor, or Ewing's tumor. If the lesions are multiple, one must consider multiple myeloma, lymphoma, metastasis, and neuroblastoma. There is no characteristic appearance of eosinophilic granuloma of bone.

JOHN B. MCANENY, M.D.

Osteochondromatosis of the Elbow. R. J. Dittrich. Am. J. Surg. **72:** 125–127, July 1946.

A brief discussion of the etiology, pathology, and clinical features precedes a case report of osteochondromatosis of the elbow. The etiology is recognized as obscure. Osteocartilaginous bodies vary greatly in size, number, and location and are derived from synovial tissue. They may either be attached to the synovia or free within the joint. Clinically the patients usually complain of arthritic pains in the joints. Loose bodies may be palpated within the joint, and roentgenography confirms their presence.

This case report is noteworthy because symptoms developed only two days after injury. X-rays and operation showed three loose osteocartilaginous bodies, almost 1 cm. in diameter, in the elbow joint.

VERN W. RITTER, M.D.

Air Arthrography as an Aid to Diagnosis of Lesions of the Menisci of the Knee Joint. E. W. Sommerville. J. Bone & Joint Surg. **28:** 451–465, July 1946.

The basis of this study is 331 knees examined by air arthrography. The procedure consists in preparing the skin as for operation, forty-eight hours before the arthrography, and wrapping the area in sterile towels. Under pentothal-sodium anesthesia, filtered air is injected into the joint and the films are obtained.

The knee is placed over a curved cassette and the following tangential views are taken: Anteroposterior, anteromedial, and posteromedial of the medial meniscus; anteroposterior, anterolateral and posterolateral of the lateral meniscus; a mediolateral and a lateromedial of the posterior aspect of the joint. An additional supero-inferior view of the patella on an occlusal film is sometimes made to demonstrate the articular surfaces of the patella and adjacent condylar articular surface. These various views give adequate definition of all of both menisci. The presence of the shadow of the popliteus is noted and its outline described.

Numerous beautiful reproductions of the various views of the knee, both normal and abnormal, are presented.

The author finds his accuracy in diagnosis rapidly improving with experience in the procedure.

JOHN B. MCANENY, M.D.

Discoid Cartilage of Knee. Stuart A. Thomson. Canad. M. A. J. **54:** 596–598, June 1946.

Of 16 patients operated upon in the past twenty years for internal derangement of the knee, only 5, ranging from five to thirteen years of age, were found to have a disk-shaped anomaly of the external cartilage; in one case the anomaly was bilateral.

Common persistent complaints are a "snapping sensation" on active movement and difficulty in walking

on rough ground or downstairs. A variably palpable tender mass along the lateral joint line anterior to the collateral ligament, an increase of medial joint play due to stretching of the external collateral ligament, and atrophy of the quadriceps, may be found. X-ray examination usually reveals widening of the lateral joint space.

Operative removal appears to give a satisfactory cure.

WILLIAM P. MARTIN, M.D.

A Case Resembling Hemangiomatosis of the Lower Extremity. David J. King. J. Bone & Joint Surg. **28:** 623–628, July 1946.

An 11-year-old boy injured his knee in April 1941. A roentgenogram shortly afterward showed no bone change, nor was any change demonstrable on a second examination in July, although there were swelling and discoloration of the skin. In February 1942, while turning in bed, the patient experienced pain for the first time, and swelling of the thigh and upper leg developed. Roentgenograms at this time showed a pathological fracture and decalcification of bone. The only other abnormal laboratory finding was a blood phosphatase of 18.2 Bodansky units.

In May 1942 the extremity was amputated at mid thigh. Examination of the tissue showed many thin-walled vessels resembling hemangioma. In February 1943, the remainder of the femur showed decalcification, with numerous punched-out areas here and in the adjoining portion of the pelvis. Biopsy yielded the same kind of tissue as in the amputated extremity. At this time roentgen therapy was given—200 kv., 50 cm. distance, h.v.l. 1.05 mm. Cu, for a total of 1,700 r to each of four ports. In July 1944, recalcification was occurring satisfactorily and the quality of the bone was more nearly normal.

JOHN B. MCANENY, M.D.

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography with Visco-Rayopake: Preliminary Report. Jacob Warren. West. J. Surg. **54:** 294–299, July 1946.

Viscorayopake is an aqueous solution of an organic iodide-containing contrast salt (diethanolamine salt of 2,4-dioxo-3-iodo-6-methyl-tetrahydro-pyridine acetic acid) together with 3.5 per cent polyvinyl alcohol. It is the latter compound which imparts to the preparation its characteristic viscosity. This new radiopaque medium, unlike the older oil preparations, is absorbed within a few hours after injection. This property obviously makes a twenty-four-hour check impossible, but it obviates the dangers of tubal occlusion by inspissated particles and later by foreign body granulomas.

Rubin, in his original publication on this substance (M. Rec. **152:** 212, 1940) pointed out that an ideal contrast medium for gynecological use should have three qualities: satisfactory radiopacity, adequate viscosity, and rapid resorbability, all of which requirements are met by viscorayopake. The toxicity of the material has been worked out in the Department of Pharmacology of Georgetown University by Kopponyi and confirmed by Rubin. It is said that the amount usually employed for uterosalpingography contains less than one-fiftieth of the maximum tolerance dose of the contrast acid and less than one-five-hundredth of the tolerance dose of polyvinyl alcohol.

The technic for hysterosalpingography with the new contrast medium is described in some detail. It differs in no important respect from the usual iodized oil technic.

Four illustrative cases are presented in the body of the article, and a report of a case of uterus didelphys demonstrated by viscorayopake is appended.

The author has had no untoward reaction of a toxic or allergic nature in his experience with this medium.

SYDNEY F. THOMAS, M.D.

A Note on the Amount of Radiation Incident in the Depths of the Pelvis During Radiological Pelvimetry. J. H. Martin and E. Rohan Williams. Brit. J. Radiol. **19:** 297–298, July 1946.

Determinations of the amount of radiation received in the depths of the pelvis during radiological pelvimetry were made in two women, one fourteen weeks and the other thirty-seven weeks pregnant, by placing a thimble chamber as high in the vaginal vault as possible. Four films were made on each patient, an anteroposterior, superior-inferior, lateral, and subpubic arch projection. In neither patient was the dose measured as much as 0.9 r.

SYDNEY J. HAWLEY, M.D.

THE GENITO-URINARY SYSTEM

Massive Perirenal Lipoma with Report of a Case. George E. Pfeiffer and Morris M. Gandin. J. Urol. **56:** 12–27, July 1946.

The authors, in adding one case of perirenal lipoma to the 200 and some odd cases of this relatively rare condition previously recorded, present an excellent concise historical background. The condition is more common in females and is seen most frequently between the ages of forty and sixty, though a case in an infant of fifteen days has been recorded. Of all reported cases, it is estimated that approximately 37 per cent are of perirenal origin. The remainder arise from the fatty renal capsule.

Pathologically the tumor contains fatty and fibrous tissues in varying proportions, the grossly mixed type being the most prevalent. Histologically the origin may be from the mesentery, omentum, or the immediate perirenal tissues. Some of these tumors have weighed over 50 pounds.

Symptoms are vague and secondary to the compression changes produced by a slowly enlarging tumor which displaces abdominal and thoracic viscera. The prognosis is regarded as grave, owing to the frequency of recurrence and a tendency to sarcomatous change. The present-day operative mortality is 20 per cent. Uninhibited, these tumors produce ca hexia and death.

Radiologically it is of importance to know that this tumor does occur. Recognition of the growth can be made from the presence of an intra-abdominal mass of varied size which compresses abdominal viscera, changing normal relationships in the process, and altering physiologic function, with elevation of the diaphragmatic leaves either unilaterally or bilaterally. Retrograde pyelographic studies show the usually marked displacement of the involved kidney. Renal calculi can frequently be found in association with the growth. Function of the affected kidney is usually greatly impaired or destroyed. The differential diagnosis must consider ovarian cyst, other abdominal tumors, ascites, pancreatic cyst, cirrhosis, and pregnancy.

The authors' patient was a 49-year-old male from whom a fibrolipoma weighing 26½ pounds was success-

fully removed. Roentgenography showed a huge tumor filling the right half and upper and middle portions of the left half of the abdomen, and displacing stomach and intestinal tract. Retrograde pyelography showed the right renal pelvis to be displaced far into the left upper quadrant of the abdomen, so that it lay farther to the left than the left pelvis.

JOSEPH P. TOMSULA, M.D.

Benign Papilloma of the Ureter. Ernest Felber. J. M. A. Georgia **35:** 200–202, July 1946.

Tumors of the ureter are rare, especially benign tumors. They produce no characteristic symptoms. If the tumor can be seen cystoscopically protruding from the ureteral orifice into the bladder, the diagnosis is easy; otherwise it rests upon the demonstration of a filling defect in the ureter by ureterography.

The author found in the literature 46 cases of benign papilloma of the ureter, to which he adds a case of his own. Of 29 cases collected up to 1932, none was diagnosed by ureterogram, while in 5 of 13 cases reported between 1932 and 1942, a diagnosis was made by that means. The difficulty in diagnosis is attributable in part to the common failure to make a complete ureterogram during retrograde pyelography and in part to the difficulty in getting the opaque medium to stay in the ureter long enough to obtain a satisfactory film.

In the case reported here, the catheter met an obstruction about 14 cm. above the ureteral orifice. Injection of hippuran and filming showed the catheter and one dilated kidney calix with no medium in the ureter. A second injection showed further filling of the calices but still no filling of the ureter. A final film, made during injection, gave the desired information, revealing a filling defect with a regular outline, above which the ureter, kidney pelvis, and calices were markedly dilated.

The author considers the value of excretory urography for the diagnosis of ureteral tumors to be definitely limited, its usefulness being based on the fact that excretory urograms will certainly show some pathologic changes, such as dilatation of the ureter, pelvis, or calices, requiring further investigation. He believes that retrograde ureteropyelography and excretory urography supplement each other and should be used together to establish a correct diagnosis. In his case the presence of a benign papillary tumor of the ureter was confirmed at operation.

BERNARD S. KALAYJIAN, M.D.

Reduplication of the Urethra. Charles Balcom Moore. J. Urol. **56:** 130–132, July 1946.

Of the five types of urethral reduplication described by Chauvin (J. d'urol. **23:** 289, 1927), the rarest is complete reduplication from glans to bladder. Such a case is reported.

A 24-year-old soldier had not recognized his abnormality until he approached maturity. He was married and the father of a normal son. Examination showed that the penis, relaxed, hung at an angle of about sixty degrees from the vertical; there was no palpable chordee; the dorsal half of the glans was split to a maximum depth of 0.5 cm., and a longitudinal sulcus split the corona. At the proximal edge of this, the preputial skin folded into a wide-mouthed channel which lay in a hemi-cylindrical depression extending back to beneath the symphysis in Buck's fascia. A 28 F sound passed easily through the normal (ventral) urethra; an 18 F could be manipulated only to the region of the prostate in the dorsal (accessory) urethra. There was no metallic contact between the two sounds.

Intravenous urograms showed no abnormality. Urethrograms were made by instilling into the bladder, per catheter, 10 per cent skiodan solution and occluding both urethras manually after voiding had begun. The two urethras were thus shown to be entirely separate to the bladder, the dorsal one being very close to the symphysis, its internal orifice lying about 2 cm. anterior to the normally placed internal meatus of the ventral urethra.

ALTON S. HANSEN, M.D.

THE BLOOD VESSELS

Congenital Dilatation of the Pulmonary Artery Due to Unequal Division of the Truncus Arteriosus Communis. O. Hatschek. Permanente Foundation M. Bull. **4:** 84–88, July 1946.

Three cases, which are probably good examples of congenital dilatation of the pulmonary artery due to anomalous division of the truncus arteriosus communis at the time of the division of the embryonal blood vessels in the 5-mm. fetus, are clearly reported, with good, large reproductions of roentgenograms. Some of the comments concerning these cases are a little difficult to understand, but they probably represent a hitherto practically unknown explanation for large pulmonary vessels with perihilar increase in the vascular marking. It is pointed out that the condition is not uncommonly misinterpreted as tuberculosis, Hodgkin's disease, or neoplasm. [The author does not mention the possibility of Boeck's sarcoid, which might well be considered.]

The German anatomist, Benecke, in 1878, first observed that the division of the truncus arteriosus communis to form the aorta and pulmonary artery was sometimes unequal, favoring one of these vessels at the expense of the other. The author points out that to be able to recognize this condition in the adult, one must be familiar with the normal roentgen anatomy of the pulmonary artery and its distribution.

Congenital dilatation of the pulmonary artery may be of any degree from an inconspicuous involvement to gigantic rounded shadows in the hili with marked widening of even the smallest pulmonary vessels throughout the lungs. In the more severe forms, a marked pulsation of the hilar vessels (hilar dance) is demonstrable fluoroscopically. SYDNEY F. THOMAS, M.D.

Technique and Interpretation of Lower Extremity Venograms. Earl R. Miller. California Med. **65:** 1–3, July 1946.

As was pointed out by Bauer (Arch. Surg. **43:** 462, 1941), venography is not to be practised as a random procedure, but as an accepted method in the diagnosis of suspected thrombosis. Localization of a block helps in determining the proper clinical or surgical management of the case. The only contraindication is the serious condition of the patient. In case of sensitivity to one dye, it can be replaced by another.

The author prefers 70 per cent diodrast as a contrast medium. A sensitivity test is done by injecting 0.1 c.c. of 35 per cent diodrast, observing the patient for two minutes and, if there is no reaction, giving a second injection of 0.5 c.c. If no signs of sensitivity appear following this, the examination may proceed.

The technic employed at the University of California Hospital is described. The needles are placed symmetrically in the veins of each foot while the patient is still on the ward. Usually a vein on the dorsum is cannulated by direct puncture, and the lumen is kept open by having saline drip through the needles slowly. A blood pressure cuff is placed around each ankle. The patient is placed supine on the x-ray table, with a 14 × 17-inch film tunnel beneath the leg and another beneath the thigh. Stationary grids are fastened to the surface of each tunnel. The tube is used at a distance of 63 in. A rectangular lead diaphragm is used on the tube so that the beam just covers the films. In the cassettes under the legs, a piece of black paper covers one of the screens. After a preliminary exposure, the blood pressure cuffs are inflated to 20 mg. Hg pressure and 20 c.c. of 70 per cent diodrast is injected through each needle at the same rate. The time for injection is about one minute. The first film is taken at 30 seconds; the tube is shifted sideways 6 inches and a second pair of films is taken at one minute; the tube is then returned to the original position and a third pair of films is taken at a minute and a half. If there is reason to suppose that the circulation is very slow, a fourth pair may be taken after another half minute.

The author quotes Baker's analysis of the venous patterns in acute and chronic deep and superficial blocks (Radiology **43:** 129, 1944). In acute superficial venous blocks with no involvement of the deep veins, excellent visualization of the deep venous system is obtained and the superficial veins are straight and of even caliber up to the point of the block. In chronic superficial blocks, the veins are tortuous and dilated. In acute deep blocks there is absence of filling of the deep vessels or partial filling which may actually demonstrate the thrombus. Frequent anastomoses of the superficial veins are seen. In chronic deep venous block, no deep veins are seen and the superficial veins are dilated and tortuous. MAURICE D. SACHS, M.D.

Experimental Study of the Vertebral Venous System—Preliminary Report. A. S. Johnstone. Proc. Roy. Soc. Med. **39:** 538–540, July 1946.

The author describes in some detail the work of Batson (Ann. Surg. **112:** 138, 1940), who demonstrated a vertebral venous system which he considered to be independent and quite distinct from the caval, pulmonary, and portal systems. This was said to consist of complex interlacing tributaries running along the spinal canal in and around the vertebral bodies, with few valves, very little permanent flow, and low pressure. Batson demonstrated this system in cadavers by the injection of vermilion water color into the deep dorsal vein of the penis. The distribution of the medium in and around the sacrum, lumbar spine, and ilia, as demonstrated radiologically, was quite comparable to the distribution of metastases in cancer of the prostate and led Batson to dismiss the old work of Handley and Willis on the possible routes of metastatic spread. Batson further contended that the free communication of the bronchial veins with the plexus around the spine clearly explained the intracranial spread of metastases from bronchial cancer and lung abscess. In a similar way he explained the source of the air embolism following pneumothorax.

The author tried to confirm Batson's findings and presents some roentgenograms showing his results. He used various media (he was unable to obtain vermilion water color) and in some instances injected cadavers soon after death, obtaining roentgenograms immediately and again after a lapse of twelve hours. Comparison of the two sets of films showed less medium in the caval system and more around the vertebrae in the later ones, suggesting that the force of gravity may play a role. In all the experiments there was evidence that the main return took place through the caval tributaries. It is concluded that the principal venous drainage from the prostatic plexus flows into the caval system regardless of the viscosity of the medium used. "It would appear," says the author, "that Batson has tried to establish the existence of a route of metastatic spread principally on the fact that the radiographs of injected pelvic and vertebral veins bear a resemblance to the radiographs of carcinomatous deposits in these bones. If his conclusions are correct, it is difficult to explain the relative absence of metastases in the transverse and spinous processes if there is such free communication between the veins." It is further pointed out that, although the bone marrow may have no lymphatics, the perineural lymphatics provide adequate channels for cells to reach the periosteum and cortical bone.

[Batson's work was also repeated by Norgore (Surgery **17:** 606, 1945. Abst. in Radiology **46:** 204, 1946), who believed it offered an anatomic explanation for so-called "paradoxical metastases."—Ed.]

SYDNEY F. THOMAS, M.D.

RADIOTHERAPY

Low-Voltage, Short-Distance Roentgen Therapy (Contact Therapy) in Dermatology. Paul Cottenot and René Bourdon. J. de radiol. et d'électrol. **27:** 319–332, 1946.

In general, the factors employed by the authors for contact irradiation of dermatological conditions are: 60 kv., 5–8 ma., 0.1 mm. Cu filter, 1–7 cm. distance. In some cases, special apparatus is required for intracavitary radiation. The illustrations accompanying the paper show the sort of epitheliomas of the face which are most commonly met with in the average hospital. Some are in difficult situations, as in the inner canthus of the eye; others are on the lip.

One point must be noted, and that is regarding the amount of radiation. The total amount given, generally in about six treatments, runs from 8,000 to 15,000 r (one case received 20,000 r; one senile keratosis received 4,000 r). This is considerably in excess of the amounts employed by most American radiologists, particularly those of us who have felt that we could standardize our procedures quite satisfactorily along the lines laid down by Widmann a few years ago. The results shown here, though good, are no better than we have been used to seeing with a half or a third of the dose employed by these French authors.

PERCY J. DELANO, M.D.

Roentgen Therapy of Pituitary Adenomas. Joseph A. Mufson and Samuel S. Blankstein. Wisconsin M. J. **45:** 680–685, July 1946.

The purpose of this report is to strengthen the argument for radiotherapy as the initial treatment of choice

in pituitary adenomas and to condemn routine surgical intervention in all cases. The authors briefly review the pathologic and clinical considerations in the three types of adenomas. Three cases, all of the chromophobe type, are reported, in which the only form of treatment was radiotherapy. In all, headache disappeared early and there was moderate to marked improvement in the visual acuity and perimetric visual fields.

Since in the average neurosurgical clinics the mortality rate for surgically treated pituitary adenomas is from 10 to 15 per cent, and since at least 50 per cent of the chromophobe adenomas and most of the eosinophilic adenomas show good results with x-ray therapy alone, it seems logical that the least hazardous form of therapy be tried first and surgical decompression be limited to those patients who fail to respond to irradiation. If, in spite of a complete course of roentgen therapy the visual fields and acuity continue to diminish, surgical decompression of the optic chiasm is indicated, with postoperative irradiation. RUSSELL WIGH, M.D.

Radiotherapy in Ophthalmology. Duncan Macdiarmid. New Zealand M. J. **45:** 224–229, June 1946.

X-Ray Treatment in Ophthalmology. Bruce Mackenzie. Ibid, pp. 230–231.

Macdiarmid presents a series of corneal lesions and malignant lesions of the lid treated by radiotherapy, by Dr. Mackenzie, after they had failed to respond to other methods of treatment. Of 15 corneal lesions, 8 showed permanent improvement, and 5 temporary improvement; two cases of metaherpetic keratitis were made worse by irradiation. Four cases of rodent ulcer of the lids were successfully treated by excision and radiotherapy and one case by radiotherapy alone. One case of epithelioma of the lower lid was treated by radiotherapy following excision.

Mackenzie treated 46 cases of basal-cell or squamous-cell carcinoma of the eyelids with roentgen rays with only one failure. For superficial basal or squamous epitheliomata of the eyelids, three treatments of 1,500 to 1,800 r, 60 to 100 kv., are given on alternate days. The eye is protected by a silvered lead shield inserted under the eyelids. The lesion, with a reasonable margin, is limited by a superficial shield of barium plasticine, accurately molded to the skin surface. In fourteen days, a moist exfoliation appears, which heals in another three weeks. Epilation of the eyelashes in the treated segment of the lid is permanent. In the more deeply seated growths, the preservation of the eye becomes of secondary importance and the integrity of the lens must be risked. In a high proportion of cases the eye may already have been removed. High-voltage radiation, 200 to 300 r daily, is administered in these cases until a total of 5,000 or 6,000 r has been reached.

Only two cases of intraocular tumor have been treated, both following enucleation. One patient with retinoblastoma is alive after fifteen years and the other, with sarcoma of the choroid, is alive after five and a half years.

Mackenzie considers radiotherapy the treatment of choice for rodent ulcers and epitheliomata of the eyelids. He believes that in certain ocular conditions resistant to ordinary forms of treatment, x-ray therapy will bring about subjective and objective improvement in about 60 per cent of the cases. Except for neoplasms, x-rays should not be used as a primary therapy weapon.

Radiation Treatment of Carcinoma of the Breast. Hugh F. Hare. S. Clin. North America **26:** 730–732, June 1946.

Radiation treatment of carcinoma of the breast is used at the Lahey Clinic either prophylactically following surgical removal of the breast or as a palliative measure in inoperable or recurrent cases. It has not been used as a method of cure without previous operation nor has it been used as a preoperative measure in an attempt to sterilize a malignant tumor.

In the postoperative course of therapy, the breast, axilla, and supraclavicular space on the side involved are all treated, through three separate portals. The total dose usually attained is 2,400 r, measured in air, using x-rays generated at 200 kv., filtered with 1 mm. of copper and 1 mm. of aluminum at a distance of 50 cm. Usually, each anterior portal is treated with 100 r a day and the lateral portal receives 150 r.

Local recurrences limited to the scar or skin are given 3,000 r, measured in air, in two divided doses of 1,500 r each, or by 2,400 r administered at one exposure. If the lesions are larger than 2 × 2 cm., the divided dose method is most efficacious, as the degree of skin reaction is less, while the end-result is approximately the same.

Bone metastases from carcinoma of the breast are usually treated with 1,500 r delivered in divided doses. This is usually successful in relieving pain. In menstruating women, most of the lesions are osteolytic; after the menopause, they may be osteolytic or osteoblastic. Following treatment, the osteolytic lesions may become osteoblastic and may remain asymptomatic for months or even years.

Radiation castration is felt to be eminently useful in a small well defined group of patients who experience greater pain in their metastatic bone lesions during menstruation than at any other time. It should be explained to such patients that relief, if it is to be obtained, will not take place for at least sixty days because the menstrual periods are not controlled immediately by irradiation treatment. SYDNEY F. THOMAS, M.D.

Untreated Carcinoma of the Breast: A Comparison of Results of Treatment of Advanced Breast Carcinoma. Phyllis Wade. Brit. J. Radiol. **19:** 272–280, July 1946.

For the purpose of determining the value of treatment of carcinoma of the breast as indicated by balancing the survival rate against the normal life expectancy, a series of 27 untreated cases of mammary carcinoma and 177 treated cases are statistically analyzed. It is pointed out, however, that survival rates are not the sole criterion on which to assess the effect of therapy, as the conditions of life, as well as the prognosis, may be affected. The severity of symptoms during the survival period is significant, though not susceptible to statistical analysis. It must also be taken into consideration that some patients with carcinoma die of intercurrent disease. Deaths from cancer of the breast and also deaths due to respiratory infections show an increase in the winter months. This may be interpreted as meaning either that death was expedited by intercurrent disease or that the cancer advanced more rapidly as a result of the infection.

The average age at onset in the author's untreated series was 56.7 years and the mean duration of life for 26 cases in which the time of onset was known was 32.6 months. One patient lived twenty-two years and one

thirteen years, while one died in a month. The largest number of deaths in any one three-month period was 6, occurring between the twelfth and fifteenth months. While the series is too small to correlate the age of onset with duration of life, a trend is indicated, namely, that there is a longer life expectancy with a more advanced age of onset.

The duration of life following the first examination is believed to furnish a better basis of comparison with treated series, in which the survival period is usually reckoned from the beginning of therapy. In the author's untreated series 11 patients died within three months of examination and 17, or more than half, within six months. All were dead within two years. A study of the treated series of 177 cases showed that treatment (radiotherapy alone or in combination with surgery) increased the survival rates by 21.5 per cent at one year, 22.5 per cent at two years, 10 per cent at three years, 10.5 per cent at four years, and 9.5 per cent at five years. Of the 177 patients treated, 39 were free of symptoms at the end of a year, 21 at two years, 15 at three years, 12 at four years, and 10 at the end of five years, so that treatment must be credited with conferring not only a rise in survival rates but also a period of healed disease for a certain proportion of the surviving patients.

The author supplements her own study of treated and untreated cases by an analysis of several series without treatment recorded in the literature, totaling 777. In this group the mean duration of the disease was 38.55 months. On this basis, treatment was shown to give an average gain of approximately 21.5 months of life. This figure is less significant, however, than the number of years lost as compared with the normal life expectancy for the various age groups, a matter which the author discusses at some length. She concludes with the following statement: "Thus the after-history of a group of patients, treated or untreated, should relate to the state of the disease at any given period, and to the duration of life compared with that of an individual of the same age but not known to be suffering from the disease." SYDNEY J. HAWLEY, M.D.

Tumor Dosage and Results in Roentgen Therapy of Cancer of the Breast. Maurice Lenz. Am. J. Roentgenol. 56: 67–74, July 1946.

The results of roentgen therapy of cancer of the breast vary with the dosage which reaches the tumor. Eighty-two patients with cancer of the breast were treated between 1933 and 1937. Thirty-eight of these were irradiated preoperatively, and 44 non-operated patients were treated by roentgen irradiation alone. In most an average tumor dose of less than 4,500 r was obtained. Invasion of the axillary nodes was diagnosed clinically in all 82 patients. In 18 of the 44 non-operated patients, skeletal or lung metastases were present on admission; 5 others had deep ulceration of the breast, 5 had satellite breast tumors, and 17 had marked edema or fixation of the breast. Only one of these patients survived five years. Disappearance of the local tumor was observed more often in the more cohesively and slower growing well differentiated neoplasms. In spite of the large roentgen-ray doses administered to these tumors, recognizable tumor cells were found in all mastectomy specimens.

Because of the experience with this group of cases, it seemed desirable to administer larger tumor doses than 4,500 r. During 1938, 1939, and 1940, 46 patients with non-operated cancer of the breast were treated solely by roentgen therapy in an attempt to arrest the growth: 2,000 r were given to each of the four quadrants of the affected breast and 1,000 to 2,500 r were added directly over the tumor in order to raise the tumor dose to 6,000 r or more. Each axilla was cross-fired with 2,500 r through an anterior and posterior axillary field and with 2,500–3,000 r through a direct axillary field. The daily dose usually was 150–200 r to two opposing breast or axillary fields. Filtration varied from 0.5 to 2 mm. Cu, or a Thoraeus filter was used. Exposure of the lungs was avoided as much as possible. Telangiectasia occurred in some instances and, in a few, irradiation sclerosis. In most, however, only slight sequelae were seen. Thirty-two cases received tumor doses of 5,500, 6,000 r, or over. In only 8 of these did cancer persist locally. Of the other 23 patients, 14 are dead and 9 are free from clinical evidence of cancer over five years after roentgen therapy. Of the 14 dead, 4 died of cardiovascular disease without clinical evidence of cancer, one of these after five years.

It is possible that, in spite of this clinical result, viable cancer cells may be locked up in the sclerotic depths of these heavily irradiated breasts and that at some time they may again start to grow actively. It is not suggested, therefore, that roentgen therapy be substituted for radical mastectomy in strictly operable cases. The important fact remains, however, that with a tumor dose of about 6,000 r or over, 23 of 31 cancers of the breast, most with axillary nodes, disappeared clinically, and in 10 of these, cancer could not be demonstrated clinically five years later.

CLARENCE E. WEAVER, M.D.

Artificial Menopause and Cancer of the Breast. L. Halberstaedter and A. Hochman. J. A. M. A. 131: 810–816, July 6, 1946.

A review of the literature pointing up the estrogenic factor in the production of carcinoma of the breast is presented and it is noted that it is difficult to draw many firm conclusions on the benefits of castration. There appears to be, however, general agreement that its effects are definitely beneficial.

The authors add 60 cases of carcinoma of the breast in which an artificial menopause was induced by x-rays. Sterilization was done chiefly for metastases. Improvement following this procedure was obtained in 56 per cent of the cases. In defining "improvement," it is emphasized that roentgenographic and objective clinical signs of regression were not considered the only valid criteria. Restriction of growth, appreciable diminution of pain, dyspnea, and other subjective symptoms, when deemed significant, were also considered as improvement. The response of metastases by location was as follows: metastases in bone, most favorably improved (69 per cent); lungs and pleura, 50 per cent improved; cutaneous metastases and local recurrences less favorably; lymph nodes showed little improvement; and brain and liver metastases none.

There was no significant difference in the relative proportion of improvement between cases classified as Stage II and III (Steinthal). Typical adenocarcinomas were more susceptible by far than anaplastic cancer to the estrogen-inhibiting influence of artificial menopause.

The improvement obtained was of short duration (from one-half to two years), probably because the estrogen deficit of the ovaries is compensated for by the

secretion of the hormone by other glands, presumably the adrenal, pituitary, thymus, and possibly others.

L. A. POZNAK, M.D.
(University of Michigan)

Roentgen Irradiation of Lung Tumors. Emilio Bianchi. Schweiz. med. Wchnschr. **76**: 652–653, July 20, 1946.

The author reports one case of pulmonary tumor with supraclavicular metastases (biopsy of these showed squamous epithelioma). Initially a collapse of the right upper lobe was present. All findings regressed following administration of 6,000 r in 30 treatments. The patient had continued well over nine months' observation.

LEWIS G. JACOBS, M.D.

Carcinoma of the Fundus Uteri. Robert J. Crossen. South. M. J. **39**: 445–451, June 1946.

The author attempts to cover the etiology, diagnosis, classification, treatment, and prevention of carcinoma of the endometrium. He points out that child-bearing is not a significant factor in the production of fundal carcinoma as compared to its significance in carcinoma of the cervix. Because of the use and abuse of ovarian hormones without sufficient knowledge of their action on the endometrium, a group of cases has been analyzed from the point of view of age at the menopause. It was found that 60 per cent of the patients with carcinoma had continued to menstruate after the age of fifty, as compared with only 15 per cent of normal subjects. These observations and results of experimental studies suggest that the prolonged action of endogenous estrogens may play an important role in the causation of endometrial cancer.

The indiscriminate use of estrogenic substances may also confuse the diagnosis of fundal carcinoma, since one cannot be certain whether bleeding in any given case is "withdrawal bleeding" or an early symptom of malignant growth. Careful curettage is emphasized as a diagnostic measure, and its repetition is advisable if bleeding persists in spite of negative findings.

Six stages of the disease are recognized: (1) endometrium only involved; (2) myometrium involved but not beyond the middle; (3) myometrium extensively involved; (4) removable adjacent structures involved; (5) irremovable structures involved while the primary mass can still be removed; (6) surrounding structures involved to such an extent as to preclude even palliative removal of the primary tumor.

Treatment, formerly by operation alone, now includes a combination of irradiation and surgery. The author favors preoperative intrauterine radium therapy and describes the method of application. The dose varies from 3,000 to 4,000 mg. hours. In cases where there is no contraindication, hysterectomy is done three or four weeks later. Where there does exist a definite contraindication to the major operative procedure, the radium dose is pushed to the limit and is followed by deep x-ray therapy (dosage not given). These patients are checked in two months and again in five months to see if additional radiation is required.

SYDNEY F. THOMAS, M.D.

The Results of Treatment in Carcinoma Colli Uteri. J. H. Müller. Schweiz. med. Wchnschr. **76**: 647–651, July 20, 1946.

This report deals with 133 patients treated for cervical carcinoma before 1939, allowing for from five to seven years follow-up. In addition to the usual four stages, a fifth group was distinguished, Stage 0, consisting of the very earliest cases discovered by colposcopy and the iodine test. Stage 0 and some of the earlier Stage I cases were treated by operation (total extirpation) with postoperative x-ray therapy. The others were treated with x-ray and radium. The distribution of cases was: Stage 0, 9 per cent; Stage I, 26 per cent; Stage II, 40 per cent; Stage III, 21 per cent; Stage IV, 4 per cent. At five years the survival rates for these stages were 100 per cent, 65 per cent, 49 per cent, 29 per cent, and 0, respectively. At seven years they were 100 per cent, 58 per cent, 37 per cent, 14 per cent, and 0. The overall absolute five-year survival rate was 51 per cent. The mortality due to treatment was 4 per cent. The author emphasizes the value of early diagnosis and prefers to use the surgical approach for most early cases. LEWIS G. JACOBS, M.D.

Primary Malignant Bone Tumors: A Review of Cases Seen in the Radiation Therapy Department of Bellevue Hospital. Rieva Rosh and Louis Raider. Am. J. Roentgenol. **56**: 75–83, July 1946.

This paper reviews experiences with 121 treated cases of primary malignant bone tumors. In order of radiosensitivity they are: endothelioma, multiple myeloma, giant-cell sarcoma, osteogenic sarcoma, and chondrosarcoma. The best hope of cure lies in the combination of intensive radiation therapy and surgery. When there is doubt about the diagnosis, it is believed a biopsy should be done. In tumors of bone where surgery cannot be employed, the parts are treated by fractional high-voltage roentgen irradiation to skin tolerance. The dose varies from 2,100 to 3,000 r per field, depending on the size of the field and individual reaction. Where amputation is to be done, dosage as high as 4,000 r per field is used.

Forty-eight cases of *osteogenic sarcoma* were treated. Twenty-two patients were below twenty years of age and 18 were over forty years of age. With amputation and irradiation there was one five-year survival among 3 cases. With excision and irradiation there were 4 five-year survivals and 4 three-year survivals among 14 cases. With irradiation alone there was a single five-year survival out of 31 cases. This patient died after eleven years with metastases in the lungs.

There were 8 cases of *secondary osteochondrosarcoma*. Three of the patients survived more than five years. One of these 3 and the other 5 died of lung metastases. One patient survived seven years under treatment consisting of a combination of excision and irradiation.

Ewing's tumor comprises a group of highly malignant endothelial sarcomas which arise in the shafts of long bones in patients during the first two decades of life. The tumor is thought to have its origin in the lymphatic channels of the bone. It metastasizes early. It is the most radiosensitive of bone tumors, and its rapid response to radiation therapy is helpful in the diagnosis of doubtful cases. The prognosis with any form of treatment is poor. Only one of the authors' 32 patients with Ewing's tumor has survived and been observed for five years. Several have been under observation for three years.

There were 18 cases of *multiple myeloma*. Eight patients died in one year and 3 during the second year; 7 lived three or more years. Radiation therapy often gives remarkable palliative results, but the disease is invariably fatal.

Giant-cell sarcoma, which in the early stage is indistinguishable roentgenographically from benign giant-cell tumor, is less radiosensitive than Ewing's tumor or multiple myeloma. It was the tumor, however, in which radiation therapy gave the greatest percentage of cures. It is believed that excision and irradiation is the best method of treatment. Of 6 patients, thus treated, 4 were alive and well three years later. Three out of 4 who had radiation therapy alone were alive and well after three years and the fourth had died of metastases.

CLARENCE E. WEAVER, M.D.

Roentgen Therapy for Leukemia. Walter C. Popp and Charles H. Watkins. M. Clin. North America **30:** 799–810, July 1946.

The classification of the leukemias used at the Mayo Clinic, the hematologic picture in the different types of leukemia, and the plan of roentgen treatment followed are presented.

Irradiation of the spleen through multiple small fields is preferred to other types of radiation therapy, such as irradiation of the long bones, flat bones, mediastinum, or of the entire body. A moderate roentgen voltage, 130 to 140 kv., has been found the most effective. The area corresponding to the spleen is divided into nine fields of approximately equal size (usually four anterior, four posterior, and one lateral). This permits nine sessions of treatments without repeated exposure of any one field. Before irradiation is started, the patient's white cell count, hemoglobin, and platelet count are investigated carefully. Beginning with one of the lower splenic fields, treatments are continued daily, each preceded by a leukocyte count, until this reaches a satisfactory level. This figure varies considerably according to the type and form of leukemia. If the count seems to decrease too rapidly, treatment is discontinued for twenty-four or forty-eight hours, in order to evaluate the significance of this decrease. Treatment carried out over a relatively short period has been found to be more pallative than haphazard treatments at irregular intervals. Irradiation is resumed when the total leukocyte count begins to show a definite and persistent increase and immature forms reappear.

Patients having relatively low counts—75,000 to 100,000 cells per cubic millimeter—usually need more irradiation for the desired effect than patients with counts of 200,000 to 300,000. The count should not be allowed to fall below certain flexible limits, depending upon the original count. The leukocytes may continue to decrease for a month or more after cessation of treatment. When patients have mild leukocytosis, their general condition seems better than when they have a so-called normal leukocyte count or leukopenia.

Myelogenous Leukemia: Roentgen rays are useless in the treatment of *acute myelogenous leukemia;* blood transfusion and other supportive measures may be of limited but doubtful value.

In spite of the rapid onset of *subacute myelogenous leukemia*, an isolated case may respond temporarily to small doses of roentgen rays. Using the nine fields as suggested, daily treatments not exceeding 75 to 80 r measured in air are usually given until the number of leukocytes reaches approximately one-third of the original count. Because of the radiosensitiveness of the cells in subacute myelogenous leukemia, there is considerable risk of excessive irradiation.

Chronic myelogenous leukemia is the least difficult form of the disease to treat and the results obtained are much more satisfactory than in other forms. The dose administered to each of the nine fields is approximately 225 r (measured in air), and the treatments are continued daily as long as the leukocyte count does not diminish too rapidly.

Roentgen therapy in the *leukopenic type* of myelogenous leukemia should be administered with caution, owing to the low total leukocyte count. The daily dose should not exceed 75 r. Often a course of treatment will produce little change in the leukocyte count, but may induce a gradual reduction in the size of the spleen, with clinical improvement. Usually not more than five sessions of treatments are necessary, and irradiation is stopped when the leukocyte count shows any tendency to decrease.

Treatment of *aleukemic myelogenous leukemia* presents much the same problem as the treatment of leukopenic myelogenous leukemia. The leukocyte count may vary from 2,000 to 10,000. Fifty to 75 r are given, and the precautionary measures described for the leukopenic phase must be observed. If the decrease in leukocytes with the initial treatment is sudden, then twenty-four to forty-eight hours should elapse before further irradiation.

Lymphatic Leukemia: Treatment for *acute lymphatic leukemia* is the same as for acute myelogenous leukemia. Roentgen therapy is of no value.

Roentgen therapy of *subacute lymphatic leukemia* is likewise of doubtful value. Greater care must be employed in the treatment of this form of leukemia than of the chronic form because of the sudden changes which may occur in the leukocyte count. The areas of involvement, whether they be cervical, supraclavicular, axillary, retroperitoneal, or mediastinal nodes, are treated with 75 to 100 r per field. One treatment is given each day until a satisfactory level is reached or as long as the leukocyte count does not decrease too rapidly.

In *chronic lymphatic leukemia*, treatment of the involved areas is given for a variable period, the number of treatments depending on the elevation of, and the effect of irradiation on, the leukocyte count. Treatment is administered to the involved lymph nodes instead of the spleen. The dosage, 225 r per field daily, is comparable to that used in chronic myelogenous leukemia.

In the *chronic macrolymphocytic and mesolymphocytic* forms of leukemia, higher doses of roentgen rays cause extreme fluctuation in the leukocyte count. A reduction of as much as 50 per cent can take place in twenty-four hours with excessive treatment. Although this rapid change is dangerous in any leukemia, the real danger in this form is not only in the rapid reduction of the white cells but in the effect on the chemical constituents of the blood; the concentration of urea may double or even triple. A daily estimation of urea concentration is as important as the daily leukocyte count, and if the concentration is increased, treatment should be interrupted for several days until it returns to normal. During the past few years at the Mayo Clinic, roentgen radiation has been directed to the renal areas for its effect on the leukemic infiltration in the kidney and improvement of kidney function. Not more than 100 to 125 r per field should be used, with a moderate voltage technic. One treatment a day is given until the leukocyte count reaches the desired level.

Monocytic Leukemia: Two types of monocytic leukemia are recognized, the Schilling type, in which the cells are derived from the reticulo-endothelial system,

and the Naegeli type, in which the monocytes are regarded as developmental products of the myeloid series. Roentgen treatment is similar to that for myelogenous leukemia.

Subleukemic Splenic Reticulo-Endotheliosis: This form of leukemia is characterized by anemia, splenomegaly, fever, purpura, leukopenia, and thrombocytopenia. Treatment presents the same problem as treatment of aleukemic and leukopenic myelogenous leukemia. Daily dosage should not exceed 75 r to small fields over the spleen. The total leukocyte count usually does not exceed 10,000 and need not be reduced below a level of 4,000 to 5,000. A good clinical response and reduction in size of the spleen can be obtained.

The authors believe that roentgen irradiation is as good a therapeutic measure in leukemia as is known at the present time.

Biological and Technical Discussion of Panroentgen Therapy [Whole Body Irradiation]. Arduino Ratti. Radiol. med. (Milan) **32:** 206–227, June 1946.

Ratti discusses the biological principles of whole body irradiation and states that the usual criteria of dosage and penetration do not apply here. He has used the method for leukemia, lymphogranuloma, and generalized malignant tumors. The best results can be expected in cases of chronic leukemia; in lymphogranulomatous and metastatic conditions, localized roentgen therapy will give better results.

CESARE GIANTURCO, M.D.

Selective Radiation Obtained by the Intravenous Administration of Colloidal Radioactive Isotopes in Diseases of the Lymphoid System. P. F. Hahn and C. W. Sheppard. South M. J. **39:** 558–562, July 1946.

Retention and Excretion of Manganese Dioxide Administered Intravenously to Humans. C. W. Sheppard and P. F. Hahn. Ibid. pp. 562–565.

In these two articles, the authors appraise the results of the use of the artificial radioactive isotopes in therapy and discuss the use and excretion of colloidal manganese dioxide. The radioactive isotopes of iodine and strontium are briefly mentioned for use in Graves' disease and bone sarcomata respectively. The authors believe that, because of its biological behavior, the use of radioactive phosphorus is favorable in polycythemia and myelogenous leukemia but is not so reasonable in the treatment of chronic lymphogenous leukemia, lymphoma, and Hodgkin's disease.

Evidence suggests that the distribution of highly dispersed sols, after injection into a vein, is in rough proportion to the amount of lymphoid tissue; one might expect to obtain a desired selective radiation effect on those tissues affected in lymphatic leukemia, reticuloendotheliosis, and in certain cases of lymphoma. With particles approaching colloidal size, as much as 90 per cent are taken up by phagocytic cells of the liver. Other participating tissues are the spleen, kidney, and lungs.

Criteria to be applied in the selection of isotopes are particle size, chemical and biological behavior of the element, its "half-life," length of ionization path, and cost of production.

Radioactive manganese, prepared in the cyclotron by bombarding chromium with deuterons, meets most of the requirements. Intravenous use of this element in a gelatin colloidal sol has not produced any clinical reaction such as nausea or fever. The early results in a comparatively few patients treated by this method of selective irradiation of the lymphoid macrophage system are reported as promising.

It is pointed out that in evaluating the therapeutic effect, retention and excretion are highly important considerations. The principal fraction of manganese released is excreted by way of the bile, appearing in the stools; in the first stool it is estimated to be of the order of 5 per cent of the initial dose. Subsequent to this the rate of excretion drops sharply and remains at a relatively low rate. Gamma-ray measurements also indicate that the mean bodily activity falls only slightly below the typical decay curve of 6.5-day manganese.

At present, conservative practice is recommended concerning the amount of 310-day manganese (the much smaller quantity of the two radioactive isotopes produced by chromium bombardment) which may be allowed to accumulate in a patient.

RUSSELL WIGH, M.D.

EFFECTS OF RADIATION

Health Protection in the Production and Use of Atomic Energy. William F. Bale. Occup. Med. **2:** 1–7, July 1946.

The author points out the magnitude of the increase in radioactivity incident to the use of nuclear energy on a world-wide scale and emphasizes the importance of a peacetime program of fundamental research painstakingly and unhurriedly carried out, in which the whole question of radioactive tolerance can be investigated in a systematic fashion. He warns of the dangers in the use of radioactive tracers. Part of the freedom from trouble in this respect in the past may have been due to the difficulty of producing dangerous amounts of most radioactive isotopes with the cyclotrons available. This safeguard probably will not exist much longer.

Postradiation Pulmonary Fibrosis. Irving Innerfield. New York State J. Med. **46:** 1572, July 15, 1946.

A case of pulmonary fibrosis, which developed following six preoperative and thirty-two postoperative deep x-ray treatments and two preoperative radium treatments for cancer of the breast, is reported. The treatment was administered by a surgeon, not a radiologist, and the dosage factors are not given.

Histopathological Study of Radionecrosis. Mauro Piemonte. Radiol. med. (Milan) **32:** 192–202, 1946.

The author has studied microscopically 24 cases of radionecrosis. He holds that the condition is primarily due to progressive traumatic changes in the small vessels of the irradiated area. Thrombotic vessels mean ischemia. The vessels already injured by radiation are in poor condition to withstand an advanced degree of ischemia and die. CESARE GIANTURCO, M.D.

Quantitative Histologic Analysis of the Effect of X-Radiation on the Interstitial Tissue of the Testes of LAF$_1$ Mice. Allen B. Eschenbrenner and Eliza Miller. J. Nat. Cancer Inst. **6:** 343–348, June 1946.

The authors attempt to demonstrate that the inter-

stitial tissue actually is increased only relatively in the testes of mice following irradiation. They do this by a very ingenious method whereby the sections of the testes are examined, and two thousand random observations are made on each testis, and the amount of interstitial tissue is thereby estimated. The irradiation was carried out in two orders of magnitude, 300 and 600 r total body irradiation in divided doses of 10 and 8.8 r, five and six times per week, respectively.

There is apparently considerable controversy as to the relative and real amounts of interstitial tissue remaining in the testes. By careful checking, it is clearly demonstrated that, although there is shrinkage of the tubules, the actual amount of interstitial tissue increases only relatively and not absolutely.

SYDNEY F. THOMAS, M.D.

Increase in Incidence of Lung Tumors in Strain "A" Mice Following Long-Continued Irradiation with Gamma Rays. Egon Lorenz, Walter E. Heston, Margaret K. Deringer and Allen B. Eschenbrenner. J. Nat. Cancer Inst. **6:** 349–353, June 1946.

Strain "A" mice of both sexes were exposed daily for eight hours to total body irradiation by radium sulfate (8.8 rγ) and were killed after nine and a half months, having received a total dose of 2,500 rγ ± 10 per cent. The incidence of pulmonary tumors was approximately 30 per cent higher in these mice than in unirradiated controls. This result is statistically significant and is interpreted as showing a weak carcinogenic action of the radiation.

The application of these results to man is difficult. The authors cite the example of the miners of Schneeberg and Joachimsthal, among whom approximately 50 per cent of deaths are due to pulmonary tumors. They place the absorbed energy per gram of lung tissue in this group at 1×10^3 ergs as compared with 2×10^6 ergs for their experimental animals. The inference is that the inhalation of radon is not the sole factor in the production of tumors in the miners.

Another point made by the authors is that their studies were made on a strain of animals with a high spontaneous incidence of pulmonary tumors, while in the general population the incidence of such tumors is low, only 0.1 per cent. The results obtained in this study, it is believed, might not be detectable in a low-tumor strain of mice. SYDNEY F. THOMAS, M.D.

EXPERIMENTAL STUDIES

Studies on Wounds of the Abdomen and Thorax Produced by High Velocity Missiles. William O. Puckett, William D. McElroy, and E. Newton Harvey. Mil. Surgeon **98:** 427–439, May 1946.

Damage to Peripheral Nerves by High Velocity Missiles Without a Direct Hit. William O. Puckett, Harry Grundfest, William D. McElroy, and J. H. McMillen. J. Neurosurg. **3:** 294–305, July 1946.

The first of these studies concerns wounds produced in the abdomen and thorax of living anesthetized cats by high velocity missiles. High-speed motion pictures showed an initial swelling (1–2 milliseconds) followed by a period of collapse (4–5 milliseconds) with subsequent external bulging of the abdominal walls of greater duration but less intensity. Microsecond roentgenograms showed the formation of a large temporary cavity coincident with the initial abdominal expansion. High-speed motion pictures revealed no such volume changes in the thorax as were observed in the abdomen and microsecond roentgenograms failed to demonstrate well-defined temporary cavities.

Autopsy studies on the abdomen showed internal damage far out of proportion to the small wounds of entrance and exit. The general effect is that of an explosion within the abdomen. Structures directly in the path of the missile are badly damaged. Structures well away from the missile track also show extensive damage, probably due to the effect on gas pockets of rapid pressure changes associated with the formation of the temporary cavity.

The object of the investigation of damage to peripheral nerves by high-velocity missiles was (1) to demonstrate visually that a nerve can be subjected to rapid displacement and deformation by a missile which does not strike the nerve directly and which produces no interruption in its gross anatomical continuity and (2) to show that such displacement of the nerve can result in its functional and anatomical damage. The sciatic nerves of anesthetized cats were visualized by radiopaque media. Microsecond roentgenograms showed that the nerve is rapidly blown aside during the expansion of the large temporary cavity which is formed by a high velocity missile which passes near but does not strike the nerve directly. Conduction studies showed that functional damage can be produced in nerves that have been subjected to such displacement, even though no break in the continuity was produced.

Histologically the loss of function was found to be due to a series of minor breaks within the nerve sheath. This type of damage can be explained by the compression and stretching which the nerve undergoes as it is rapidly blown aside during the expansion of the temporary cavity which forms in the tissues immediately after the passage of the missile. The importance of recognizing this type of nerve injury before attempting drastic operative measures is emphasized.

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